Project Status Report

High End Computing Capability
Strategic Capabilities Assets Program

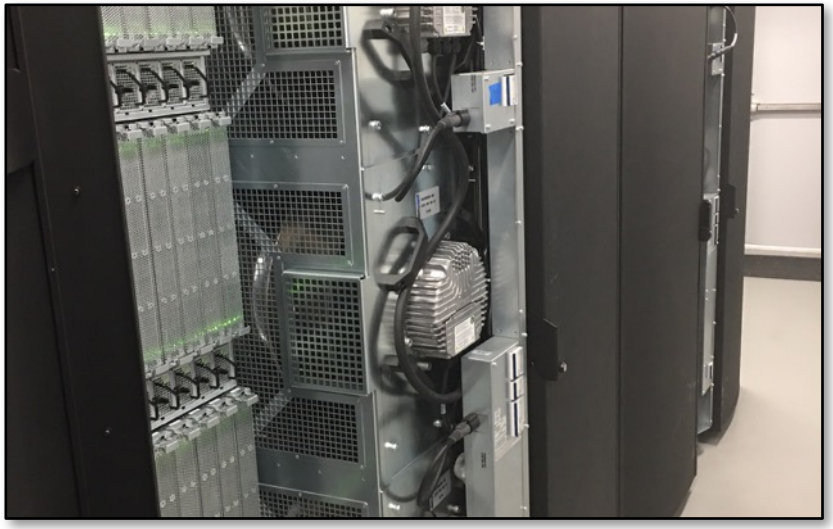
October 10, 2017

Dr. Rupak Biswas – Project Manager
NASA Ames Research Center, Moffett Field, CA
Rupak.Biswas@nasa.gov
(650) 604-4411

Electra Supercomputer Augmented with New Skylake Processors

- The HECC Supercomputing Systems team augmented the Electra supercomputer with the latest generation Intel Xeon Gold 6148 (Skylake) processors.
- This expansions adds 1,152 Skylake nodes to Electra, increasing the system's total peak performance from 1.23 to 4.78 petaflops.
- The Skylake nodes have the latest generation Extended Data Rate (EDR) InfiniBand (IB) and is interoperable with Electra's existing Fourteen Data Rate (FDR) IB. EDR IB provides a 100 Gb/s interconnect and is backwards compatible with Electra's existing FDR 56 Gb/s fabric.
- The augmentation will be available to the general user community in mid-October after system testing and an SBU rate calculation.

Mission Impact: To meet NASA's rapidly increasing requirements for high-performance computing, HECC must regularly and significantly upgrade and replace the supercomputing resources provided to the agency.



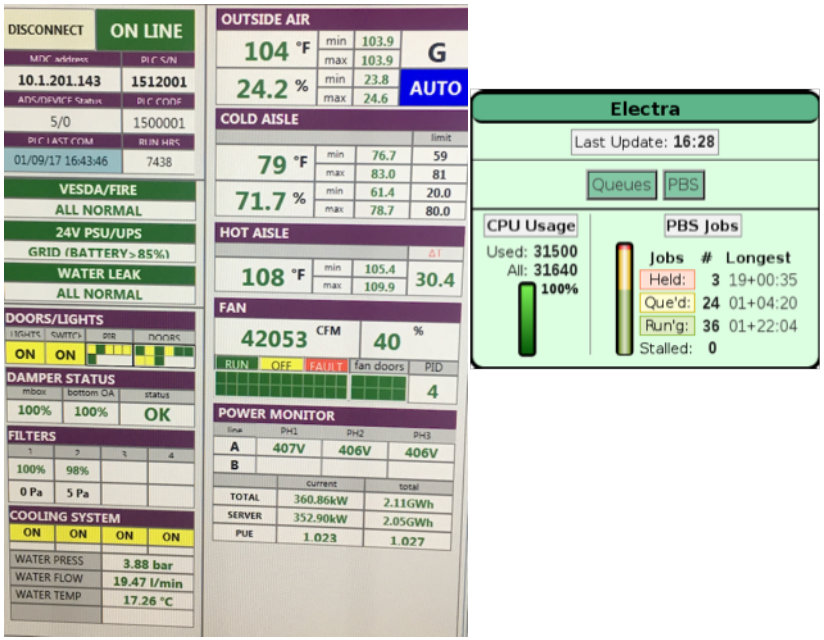
The expansion of Electra utilizes HPE's E-cell design, which is a liquid cooled, high-density design. An E-cell consists of two 42U E-racks, which are separated by a cooling rack. The E-Cell is a sealed unit and uses a closed-loop cooling system to provide efficient heat removal.

POCs: Bob Ciotti, bob.ciotti@nasa.gov, (650) 604-4408, NASA Advanced Supercomputing (NAS) Division;
Davin Chan, davin.chan@nasa.gov, (650) 604-3613, NAS Division, CSRA LLC

The Heat is on, But Electra Keeps Cool!

- The Modular Supercomputing Facility was designed to use outside air to cool the Electra supercomputer.
- On September 1, 2017, at 4:34 p.m., the outside air temperature at NASA Ames reached a record high of 104°F. The MSF cooled the outside air by evaporating water into the incoming air stream.
  - Evaporative media saturated with water yielded a 25°F temperature drop.
  - Cold aisle temperature stayed within the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Operational Guidelines of 59°-81°, without mechanical refrigeration.
- Electra was 100% utilized with a power draw of 353 kilowatts (kW).
- Approximately 2,500 gallons of water and 8 kW of power were used to cool Electra on Sept.1.
  - If Electra had been in building N258, 5,000 gallons of water and 120 kW of power to cool would have been used.
- The MSF is providing NASA users with a robust facility that is environmentally friendly, saves money in utilities, and is dependable.

Mission Impact: Electra is already providing NASA its return on investment by providing a stable robust modular supercomputing facility for HECC users.



Photographs of the control screen for the Electra module; showing CPU utilization and operating conditions.

POC: Leigh Ann Tanner, leighann.tanner@nasa.gov, (650) 604-4468, NASA Advanced Supercomputing Division, CSRA LLC

HECC Property Management Achievements in 2017

- Property custodians responsible for HECC/NAS property tracked more than 1,500 pieces of decaled equipment with a value of more than $128.7 million. Each piece of equipment requires multiple updates through the life cycle of its use.
- Custodians successfully completed the Annual equipment inventory three months earlier than last year's inventory, with a 99.93% scan rate, an improvement over 2016 numbers.
- HECC/NAS custodians were interviewed by Ames Logistics department staff for best practices and innovative onsite procedures, to be shared with other Ames Custodians.
- The ongoing tracking and management of equipment during FY17 included:
  - RFID retagging of more than 130 pieces of equipment.
  - Ames Logistics used HECC's property waiver memo as the best-practice example for all other groups.
  - Tagging 181 new pieces of equipment.
  - Excessing 197 pieces of equipment.
  - Resolution of more than 750 tickets, most relating to equipment location and ownership updates.

Mission Impact: Accurate tracking of assets through their life cycle and removal of NASA data prior to system disposal ensures control of government equipment and prevents loss of NASA data.

During the annual equipment inventory, HECC property custodians account for all equipment associated with the NASA Advanced Supercomputing (NAS) facility, including all components of the Pleiades supercomputers and associated hardware.

POC: Judy Kohler, judy.j.kohler@nasa.gov, (650) 604-4303, NASA Advanced Supercomputing Division, CSRA LLC

HECC Facility Hosts Several Visitors and Tours in September 2017

- HECC hosted 8 tour groups in September; guests learned about the agency-wide missions being supported by HECC assets, and some groups also viewed the D-Wave 2X quantum computer system. Visitors this month included:
  - Richard J. Gilbrech, Director, Stennis Space Center, Ken Human, Associate Director, and Rodney McKellip, Assistant to the Director, visited the NAS facility as part of their tour of NASA Ames.
  - Navin Shenoy, Vice President and General Manager of the Data Center Group at Intel Corporation, was briefed by NAS Division management.
  - Three computer science researchers from the Japan Aerospace Exploration Agency (JAXA) were given a technical review of HECC/NAS.
  - Daniel Ramos, FBI supervisory special agent, Joint Terrorism Task Force (JTTF) for the San Francisco Office, accompanied by his JTTF Squad comprised of approximately six special agents and intelligence analysts who received a HECC/NAS overview, tour, and security plan brief.
  - Jeff Volosin and Juan Cifuentes, members of the Transiting Exoplanet Survey Satellite (TESS) team from Goddard Space Flight Center received a HECC/NAS overview and visualization review.
  - 20 new interns from the NASA Ames Intern Program.

Christopher Buchanan, HECC networking, security, and facilities lead, gives a computer room presentation to NASA student interns.

POC: Gina Morello, gina.f.morello@nasa.gov, (650) 604-4462, NASA Advanced Supercomputing Division

Papers

- "**The Stellar IMF from Isothermal MHD Turbulence**," T. Haugbolle, P. Padoan, A. Nordlund, arXiv:1709.01078 [astro-ph.GA], September 4, 2017. * *https://arxiv.org/abs/1709.01078*
- "**The Effects of Magnetic Fields and Protostellar Feedback on Low-Mass Cluster Formation**," A. Cunningham, et al., arXiv:1709.01277 [astro-ph.GA], September 5, 2017. * *https://arxiv.org/abs/1709.01277*
- "**Inefficient Angular Momentum Transport in Accretion Disk Boundary Layers: Angular Momentum Belt in the Boundary Layer**," M. Belyaev, E. Quataert, arXiv:1709.01197 [astro-ph.HE], September 5, 2017. * *https://arxiv.org/abs/1709.01197*
- "**Hidden Founders? Strong Bottlenecks and Fine-Scale Genetic Structure in Mangrove Populations of the Cameroon Estuary Complex**," M. Ngeve, T. Van der Stocken, D. Menemenlis, N. Koedam, L. Triest, Hydrobiologia, September 5, 2017. * *https://link.springer.com/article/10.1007/s10750-017-3369-y*
- "**Super-Eddington Accretion Disks Around Supermassive Black Holes**," Y.-F. Jiang, J. Stone, S. Davis, arXiv:1709.02845 [astro-ph.HE], September 8, 2017. * *https://arxiv.org/abs/1709.02845*
- "**Dynamics of Mixed Convective–Stably-Stratified Fluids**," L.-A. Couston, D. Lecoanet, B. Favier, M. Le Bars, Physical Review Fluids, vol. 2, September 13, 2017. * *https://journals.aps.org/prfluids/abstract/10.1103/PhysRevFluids.2.094804*

** HECC provided supercomputing resources and services in support of this work*

Papers (cont.)

- "**The Dehydration of Water Worlds via Atmospheric Losses**," C. Dong, et al., The Astrophysical Journal Letters, vol. 847, no. 1, September 14, 2017. * *http://iopscience.iop.org/article/10.3847/2041-8213/aa8a60/meta*
- "**Large Wind Shears and Their Implications for Diffusion in Regions with Enhanced Static Stability: The Mesopause and the Tropopause**," H.-L. Liu, Journal of Geophysical Research: Atmospheres, published online September 19, 2017. * *http://onlinelibrary.wiley.com/doi/10.1002/2017JD026748/full*
- "**An Assessment of Ground Level and Free Tropospheric Ozone Over California and Nevada**," E. Yates, et al., Journal of Geophysical Research: Atmospheres, published online September 19, 2017. * *http://onlinelibrary.wiley.com/doi/10.1002/2016JD026266/full*
- "**Use of Cloud Radar Doppler Spectra to Evaluate Stratocumulus Drizzle Size Distributions in Large-Eddy Simulations with Size-Resolved Microphysics**," J. Rémillard, et al., Journal of Applied Meteorology and Climatology, vol. 56, no. 9, September 20, 2017. * *http://journals.ametsoc.org/doi/abs/10.1175/JAMC-D-17-0100.1*
- "**Light Scattering by Hierarchical Aggregates**," L. Kolokolova, et al., Journal of Quantitative Spectroscopy and Radiative Transfer, September 21, 2017. * *http://www.sciencedirect.com/science/article/pii/S0022407317304910*

** HECC provided supercomputing resources and services in support of this work*

Papers (cont.)

- "**Kinetic Alfvén Turbulence: Electron and Ion Heating by Particle-in-Cell Simulations**," R. S. Hughes, S. P. Gary, J. Wang, T. Parashar, The Astrophysical Journal Letters, vol. 847, no. 2, September 25, 2017. *
  http://iopscience.iop.org/article/10.3847/2041-8213/aa8b13
- "**Enhancing Open National Combustion Code and Application of Energy Efficient Engine Combustor**," K. Miki, J. Moder, M.-S. Liou, Journal of Propulsion and Power, published online August 31, 2017.
  https://arc.aiaa.org/doi/10.2514/1.B36610

** HECC provided supercomputing resources and services in support of this work*

Presentations

- "**OpenMP Doacross Loops in Practice: A Mini-Application Case Study**," G. Jost, H. Jin, OpenMPCon, Stony Brook University, September 18-20, 2017. *
  http://iopscience.iop.org/article/10.3847/2041-8213/aa8b13/meta
- **9th Ablation Workshop,** Bozeman, MT, August 30-31, 2017
  - "**Particle Methods for Tortuosity Factors in Porous Media**" J. Ferguson
  - "**Development of Type 3 Ablator Response Model under the ESM Project**," N. N. Mansour
  - "**Investigation of the High-Energy Oxidation of FiberForm from DSMC Analysis of Molecular Beam Experiments**," A. Borner
  - "**Flow-Tube Reactor Experiments on the High Temperature Oxidation of Carbon Weaves**," F. Panerai
  - "**Full-Scale Mars Science Laboratory Tiled Heatshield Material Response**," J. Meurisse

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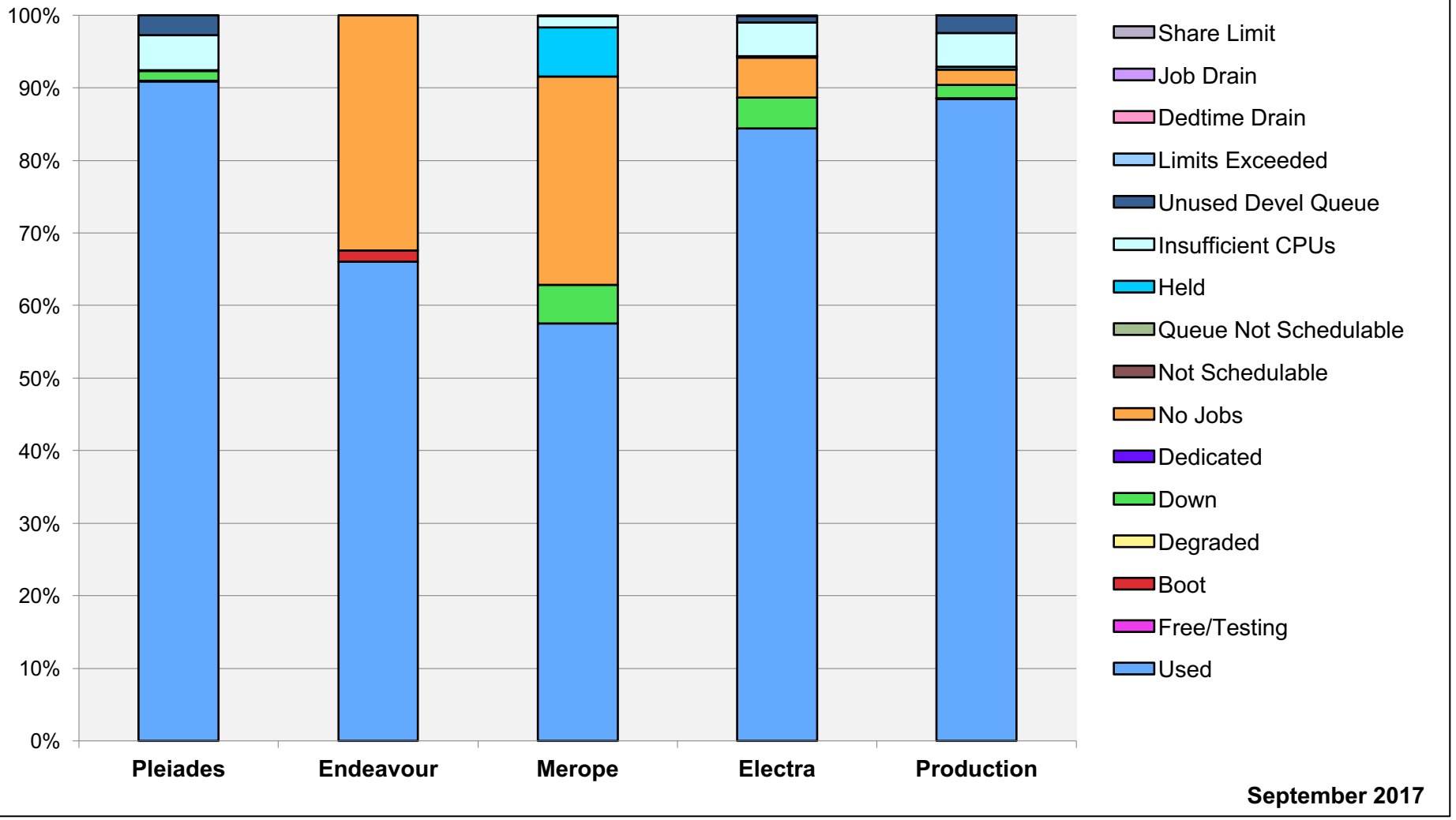
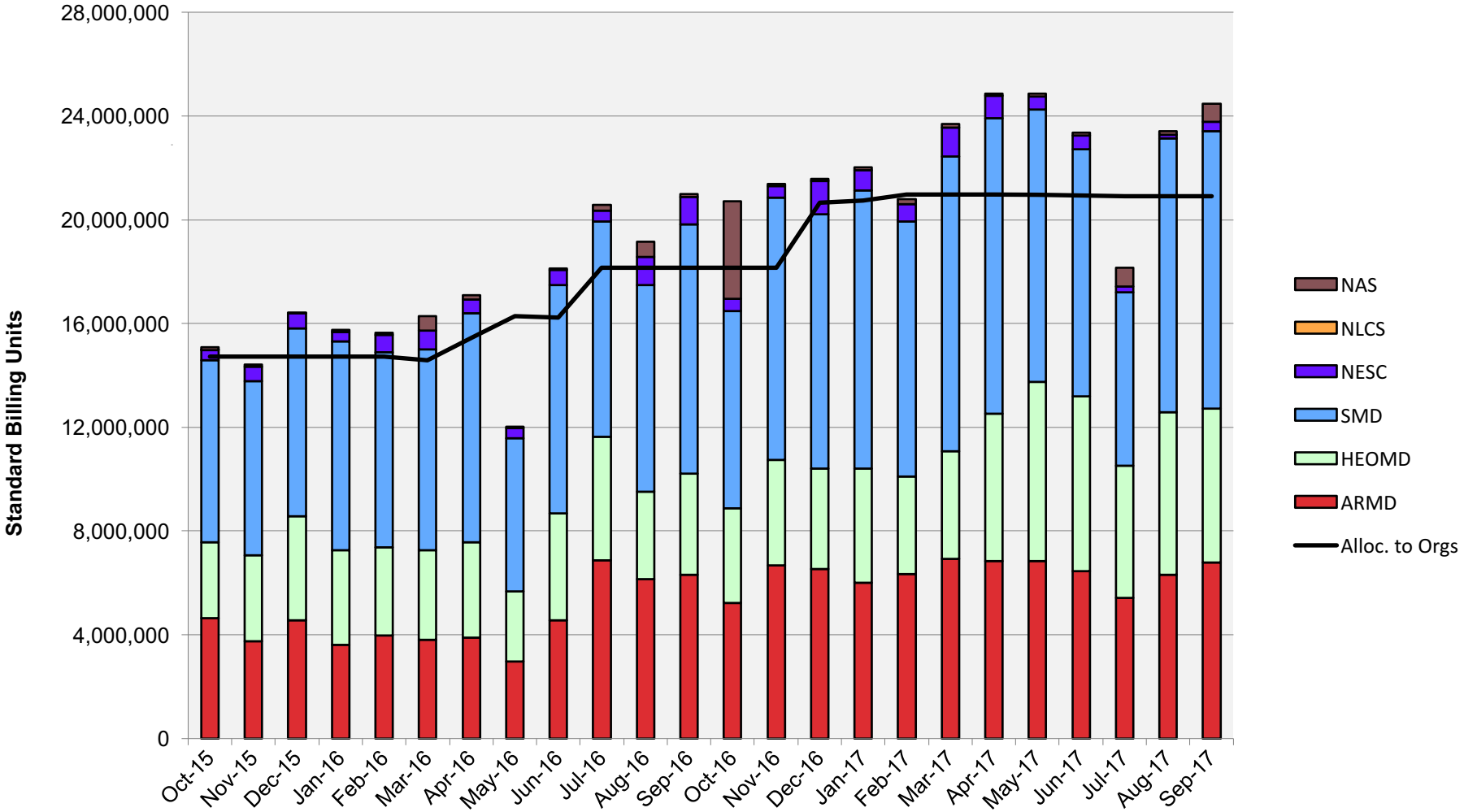
News and Events

- **NASA Supercomputing Strategy Takes the Road Less Traveled**, *The Next Platform*, August 31, 2017—For a large institution playing at the leadership-class supercomputing level, NASA tends to do things a little differently than its national lab and academic peers. NAS Advanced Computing Branch Chief Bill Thigpen explains the benefits of taking the modular route at NASA's Ames Research Center, starting with the Electra supercomputer. *https://www.nextplatform.com/2017/08/31/nasa-supercomputing-strategy-takes-road-less-traveled/*

HECC Utilization



HECC Utilization Normalized to 30-Day Month



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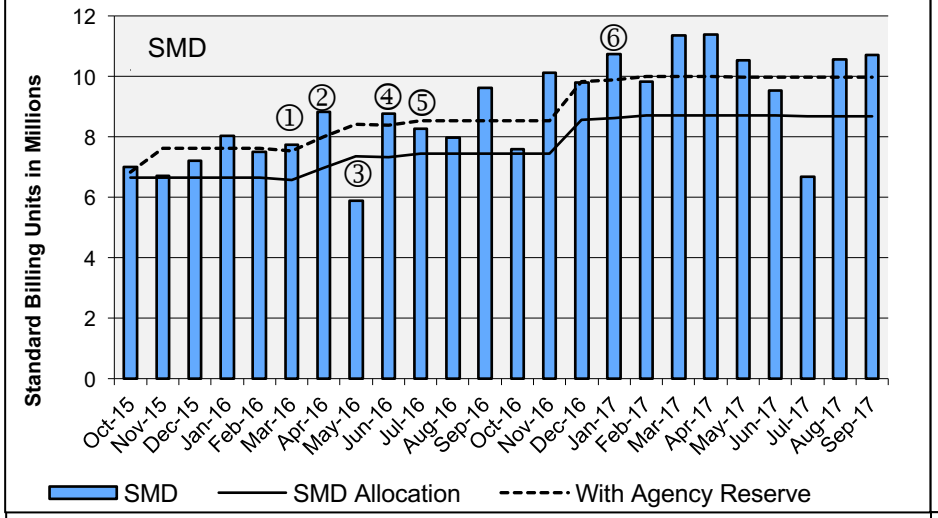
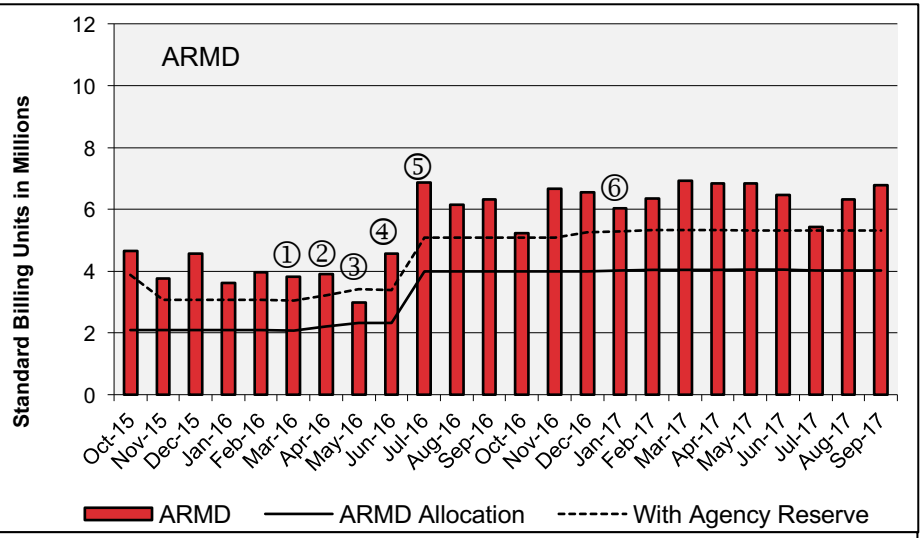
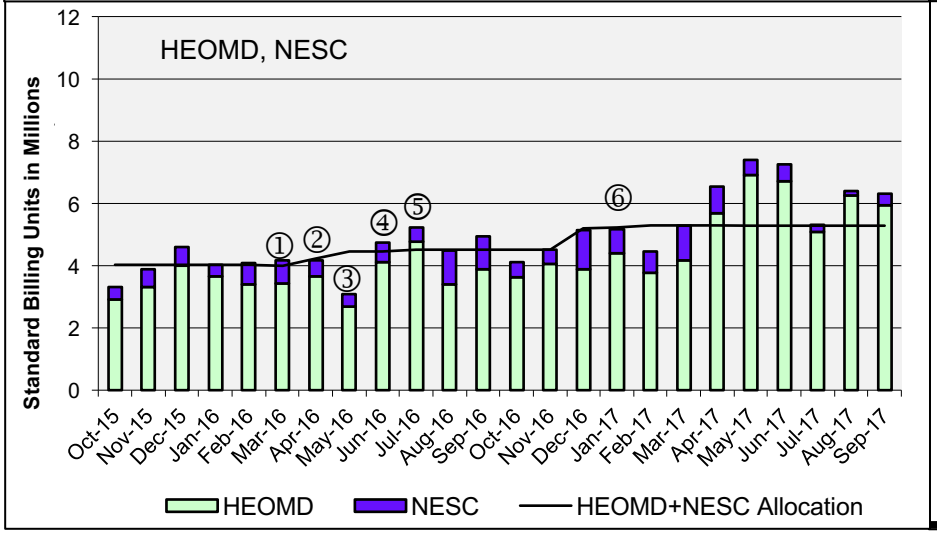
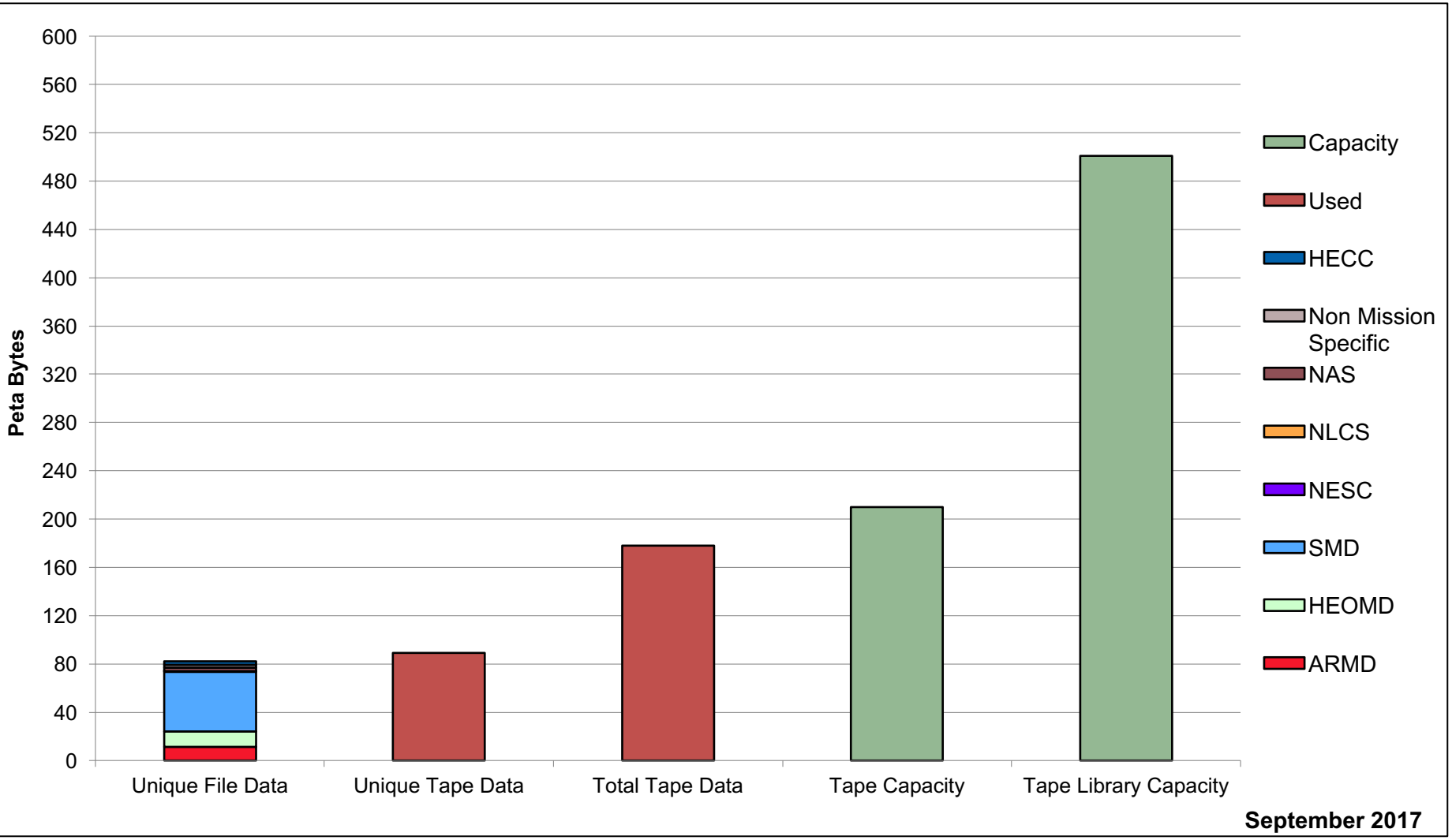






① 16 Westmere racks retired from Pleiades
② 10 Broadwell racks added to Pleiades
③ 4 Broadwell racks added to Pleiades
④ 14 (All) Westmere racks retired from Pleiades
⑤ 14 Broadwell Racks added to Pleiades
⑥ 16 Electra Broadwell Racks in Production, 20 Westmere 1/2 racks added to Merope

Tape Archive Status



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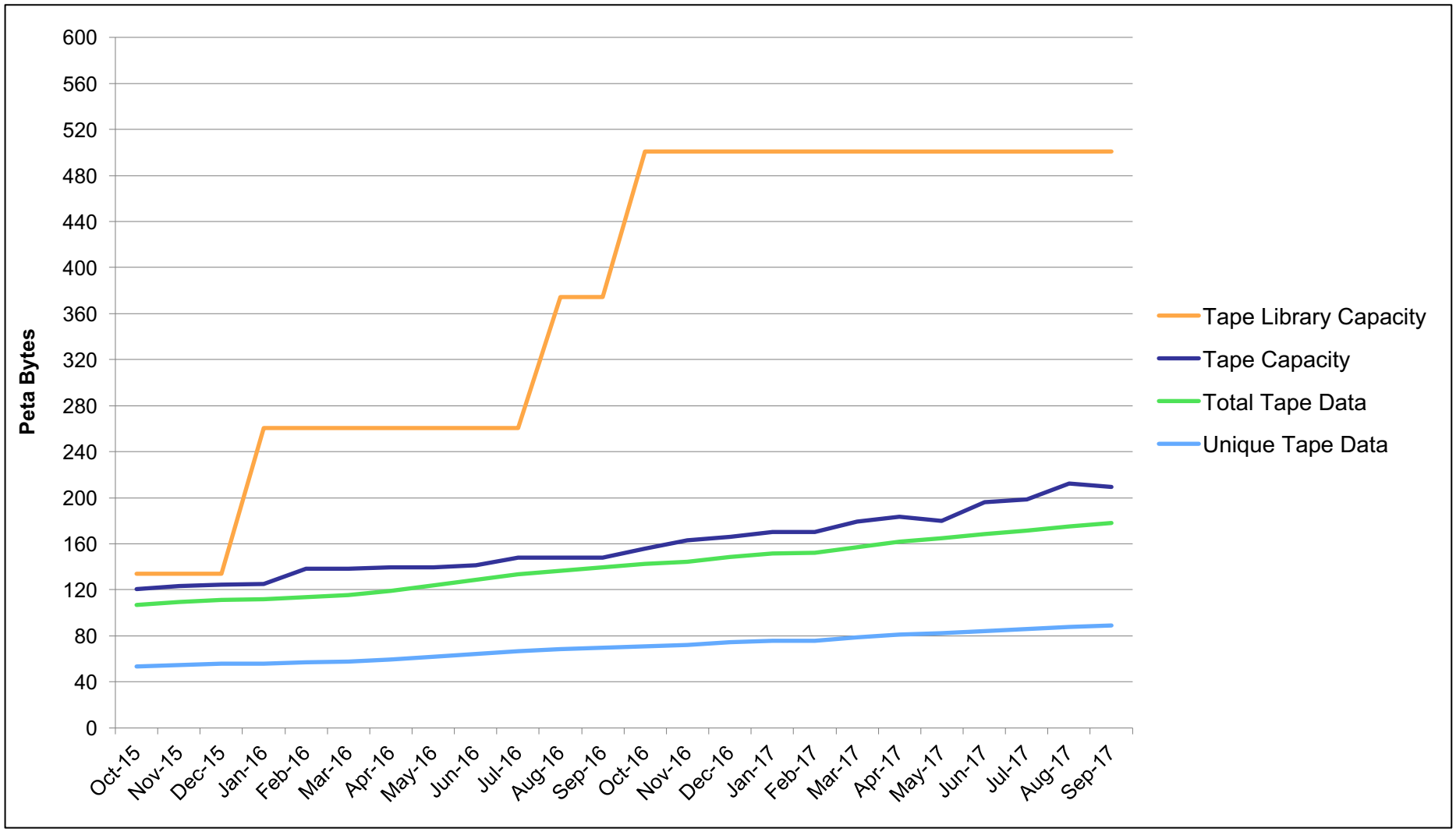
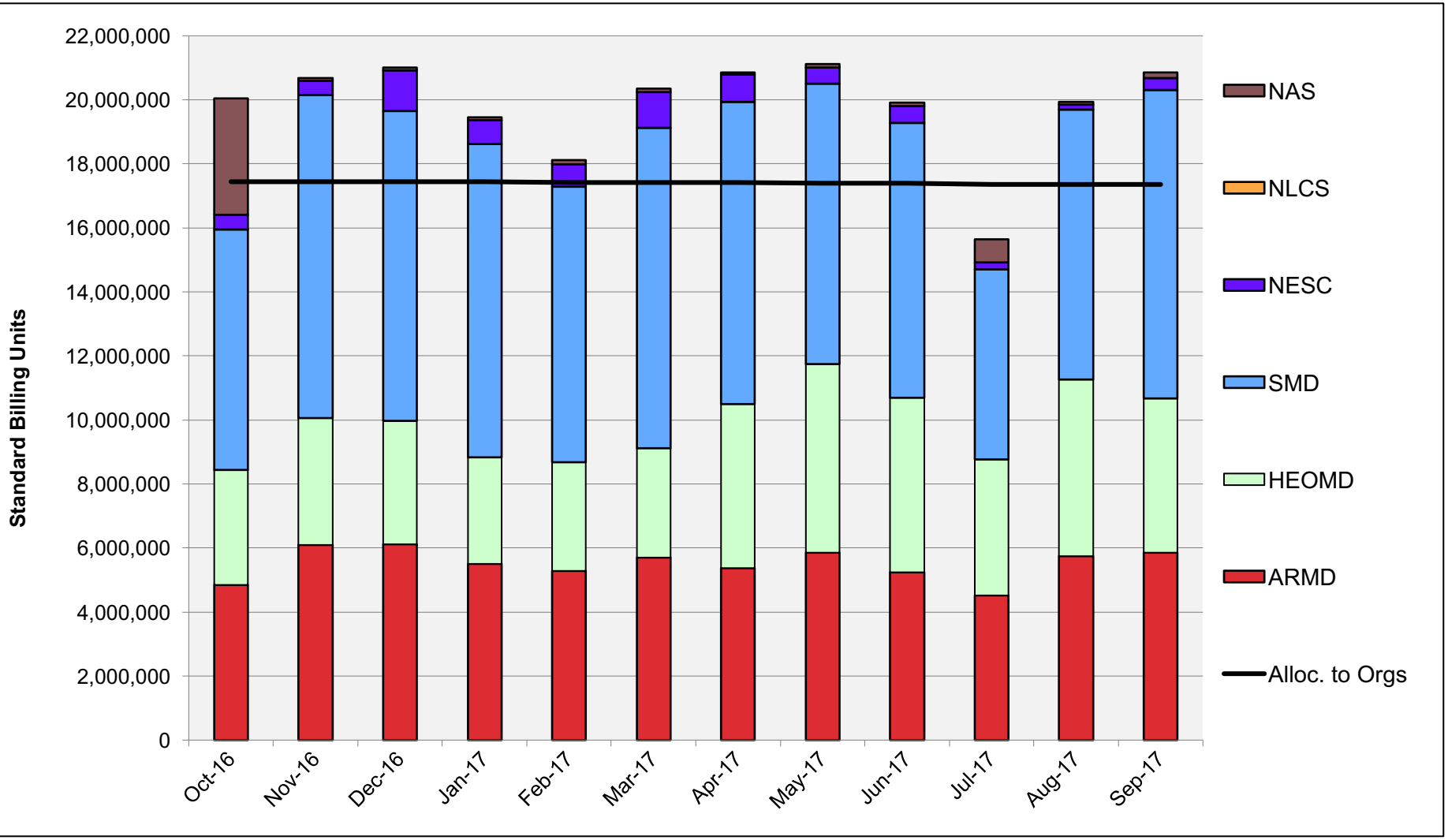
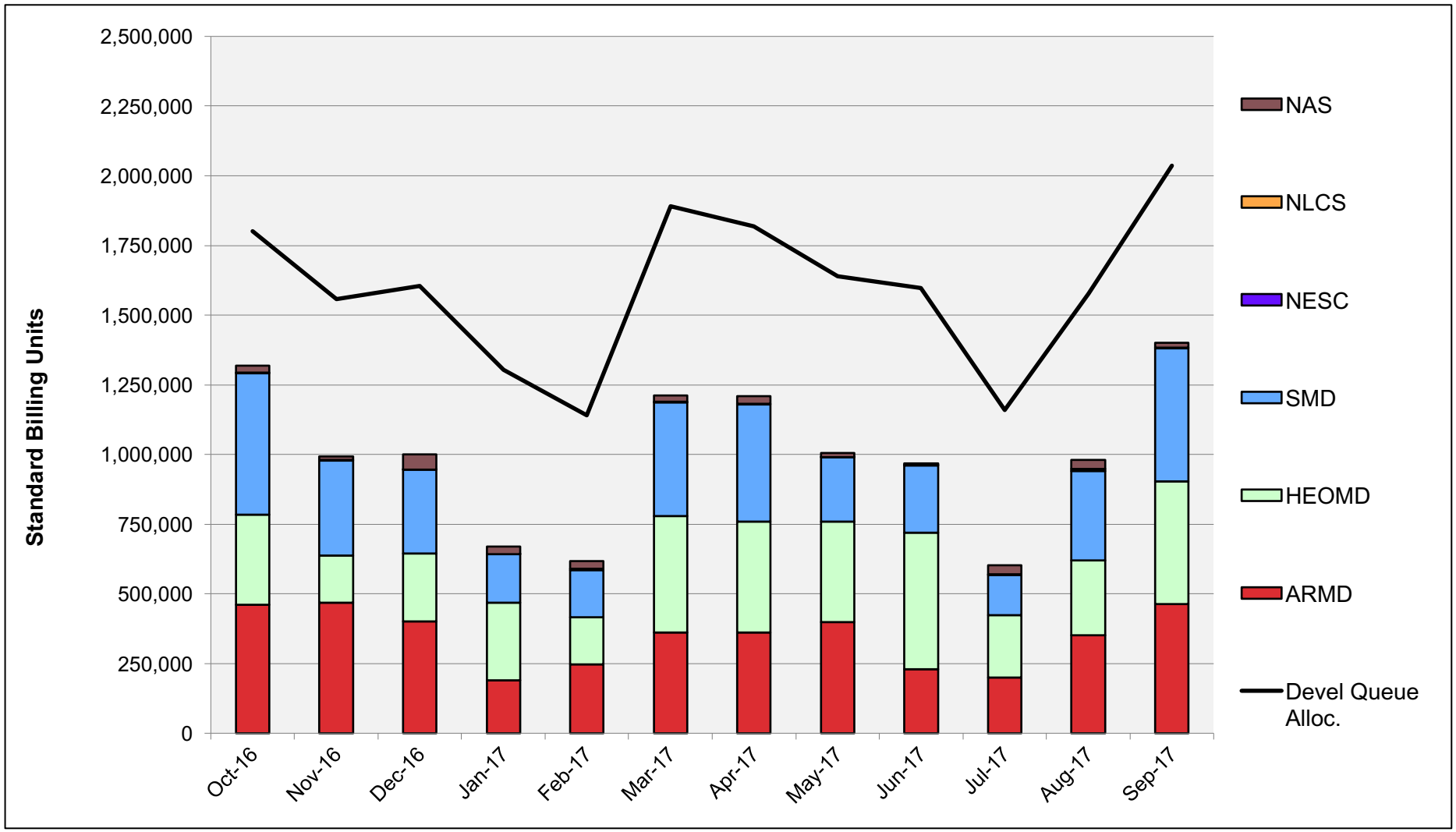


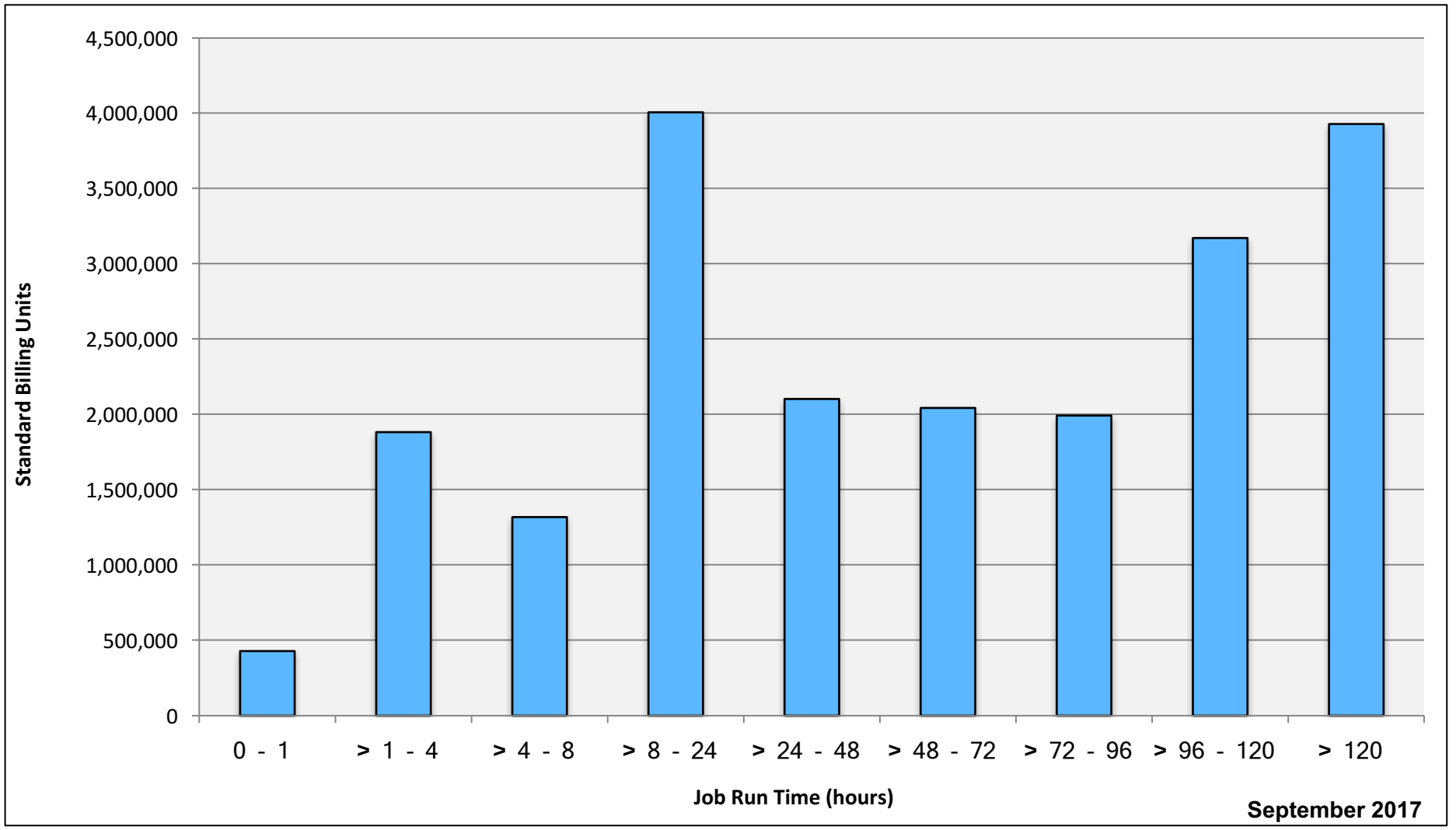
Pleiades:
SBUs Reported, Normalized to 30-Day Month



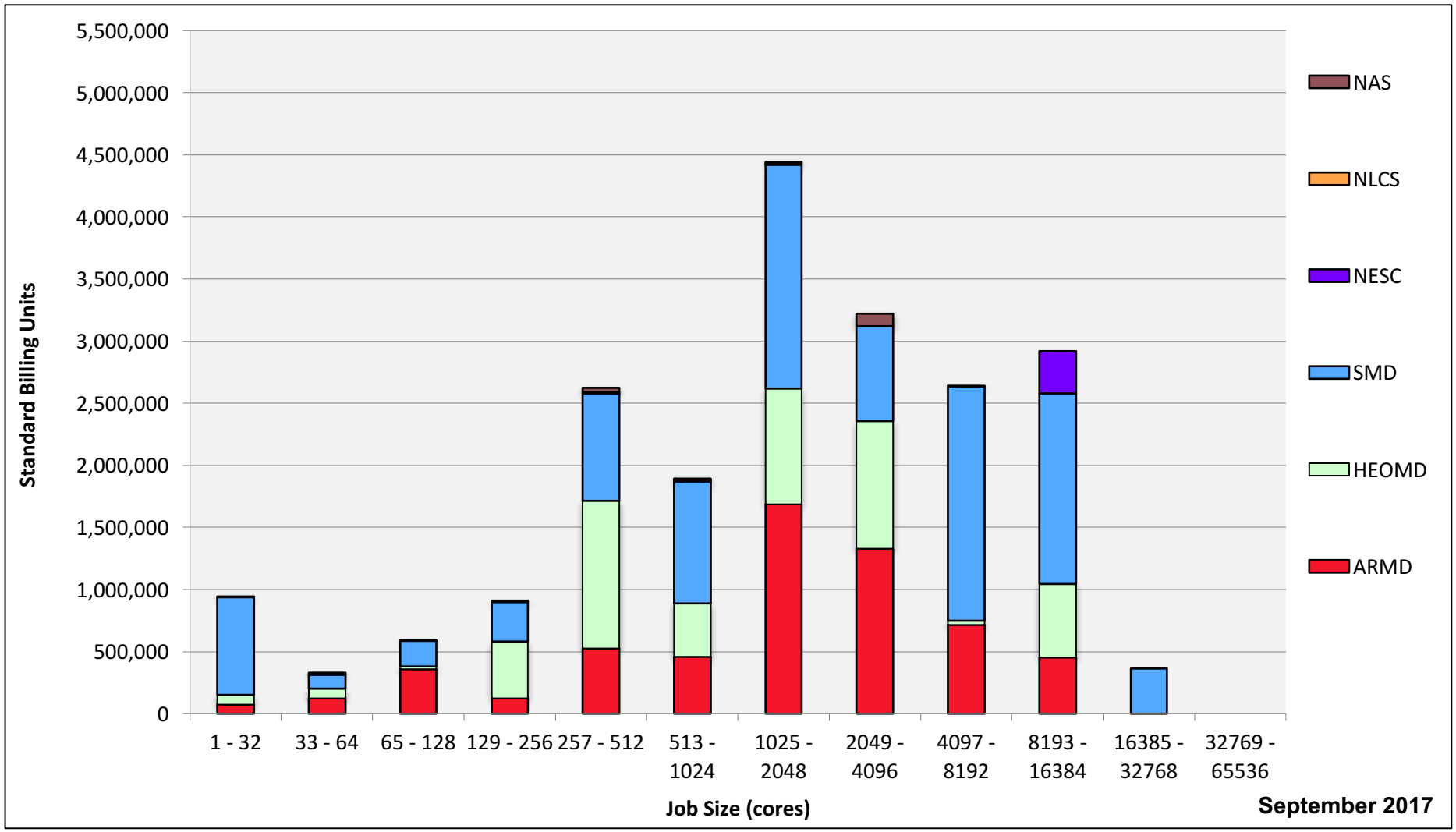
Pleiades:
Devel Queue Utilization



Pleiades:
Monthly Utilization by Job Length



Pleiades:
Monthly Utilization by Size and Mission



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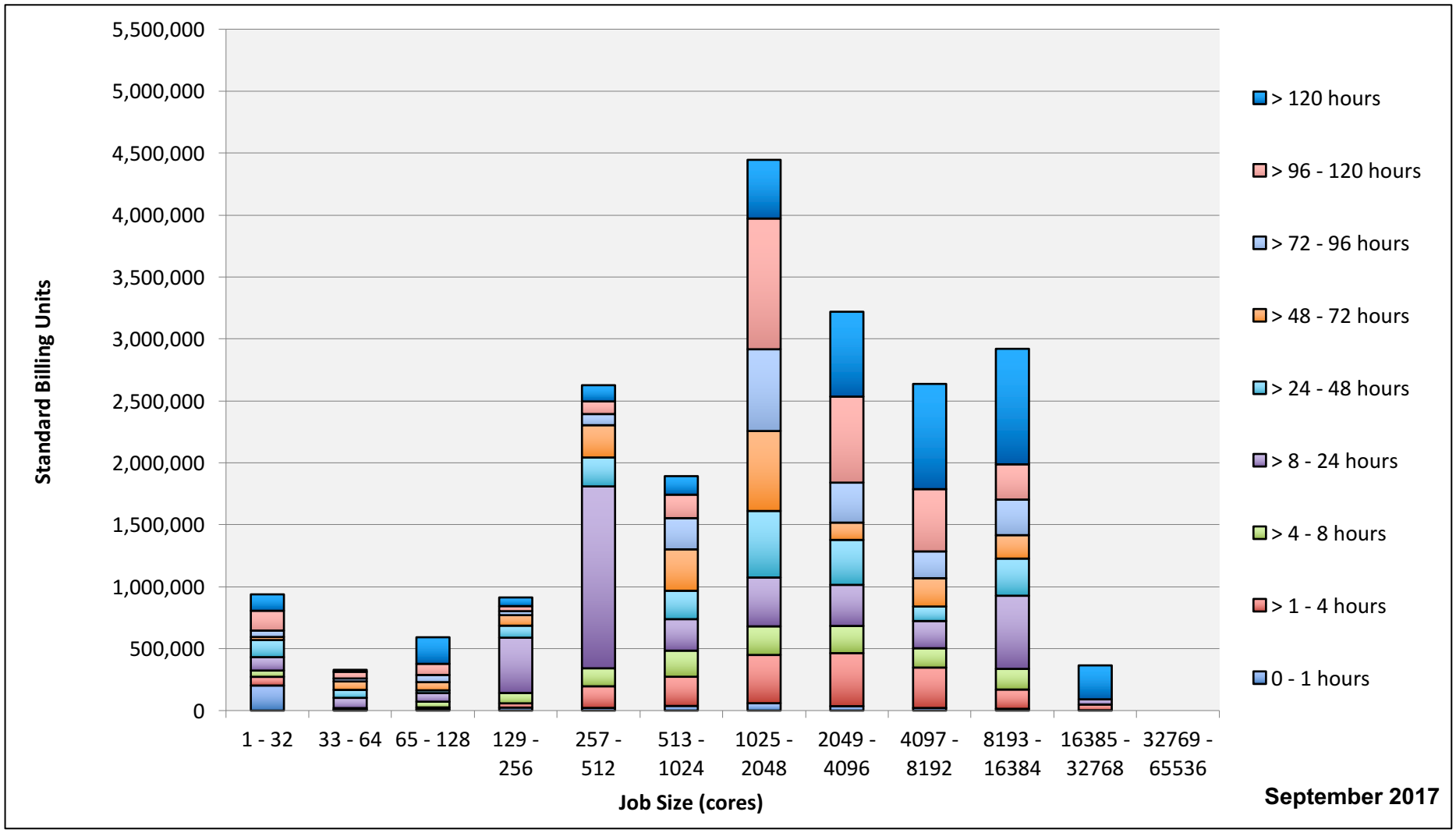
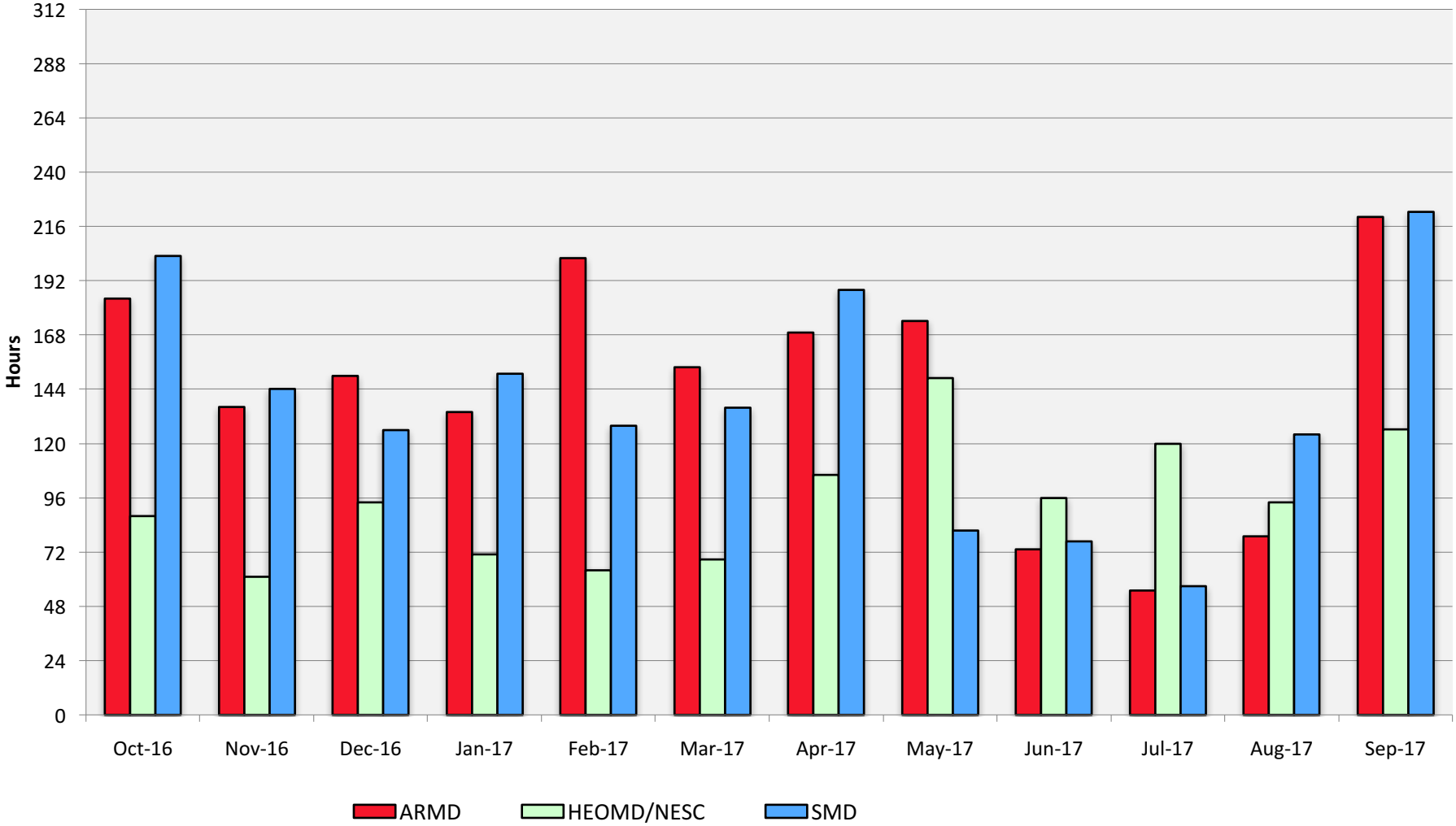
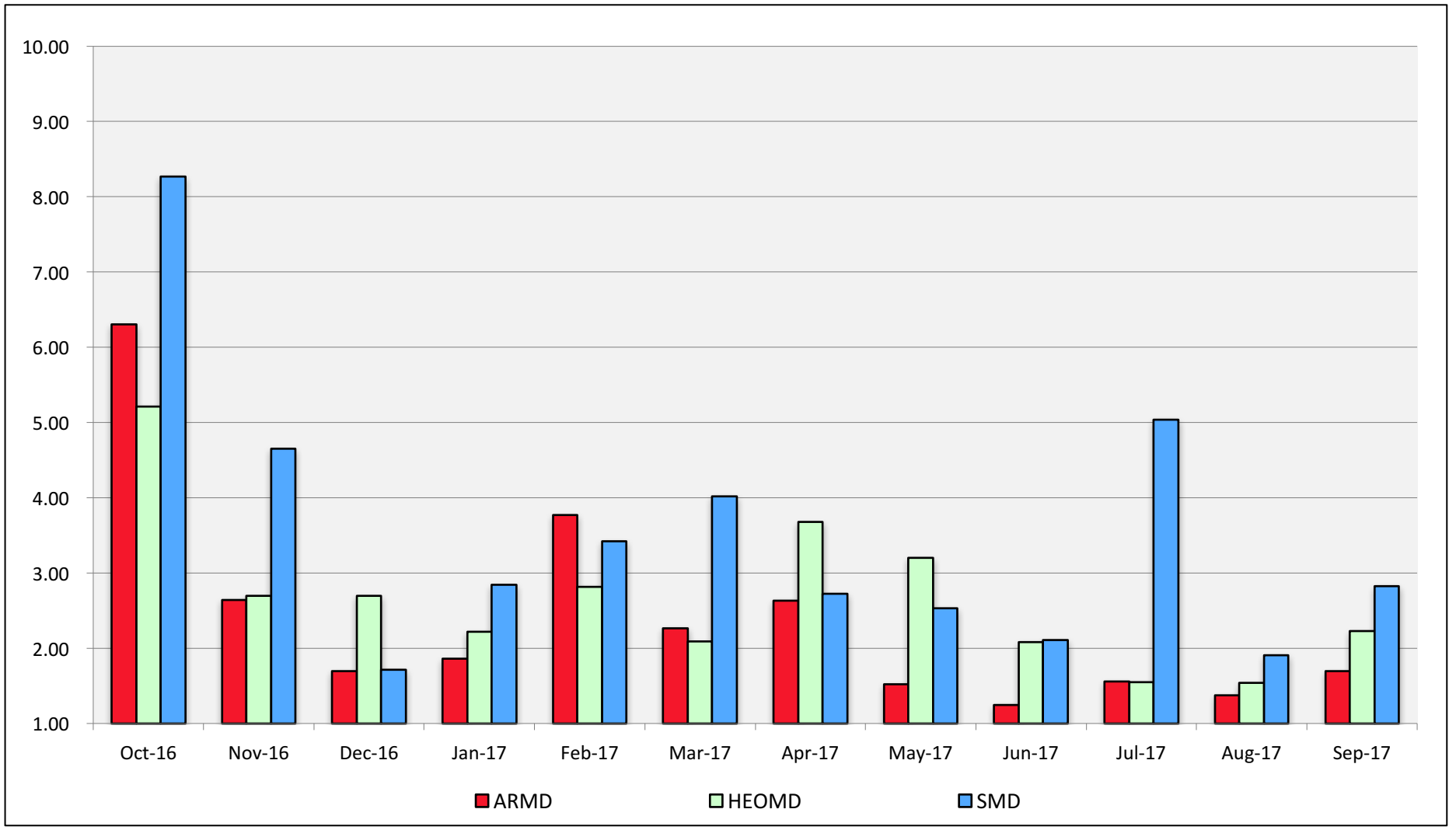


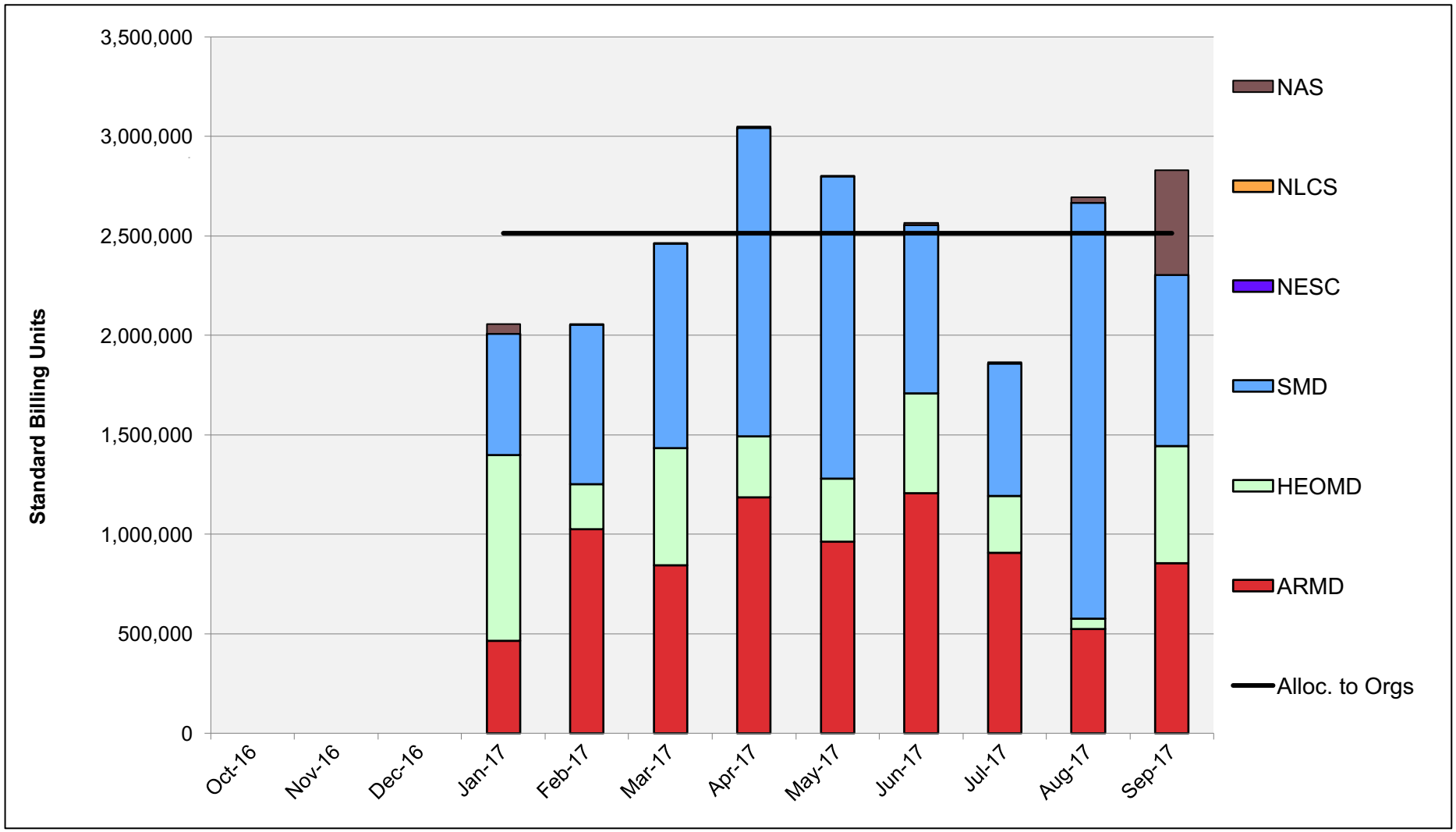
Pleiades:
Average Time to Clear All Jobs



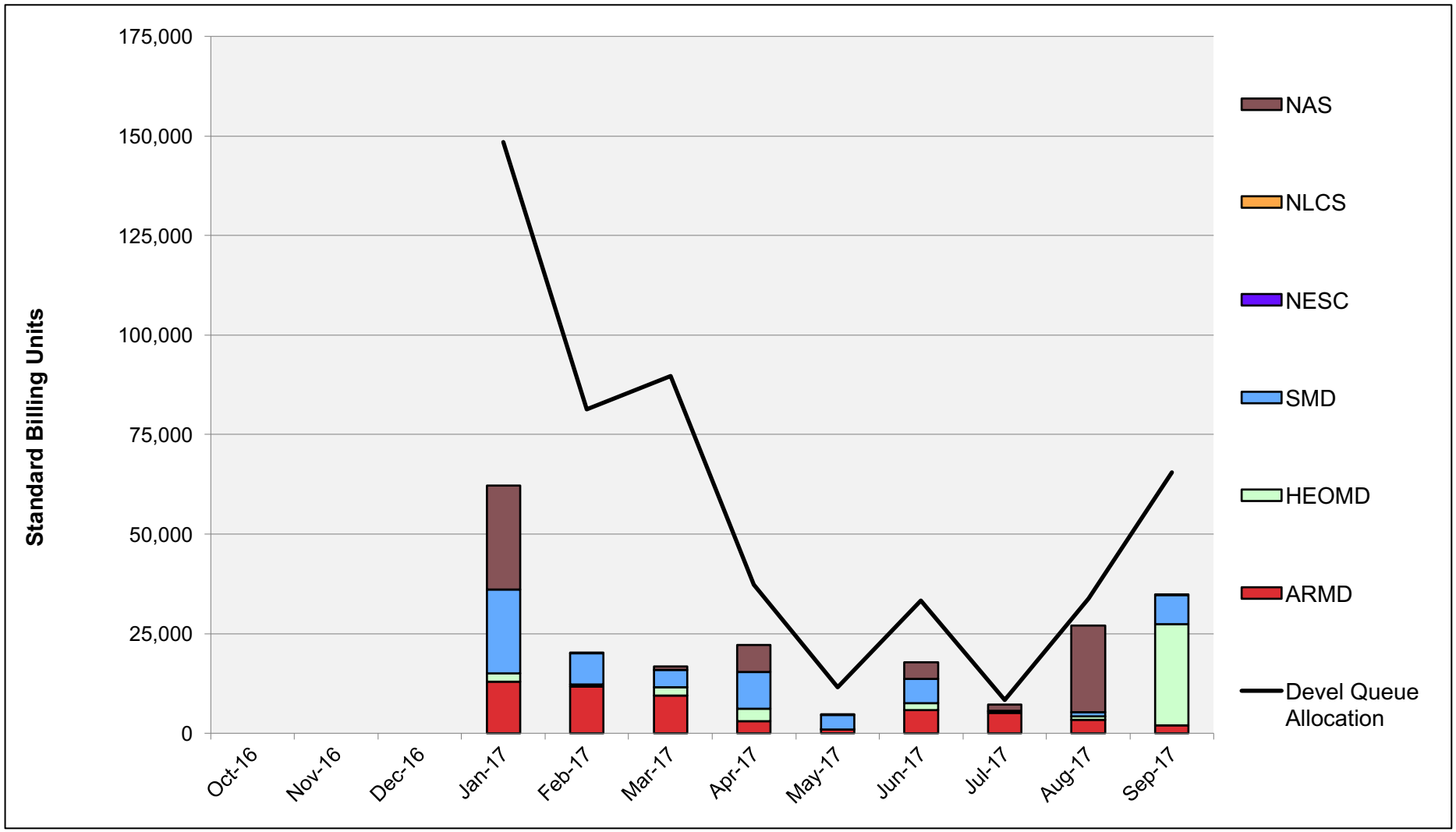
Pleiades:
Average Expansion Factor



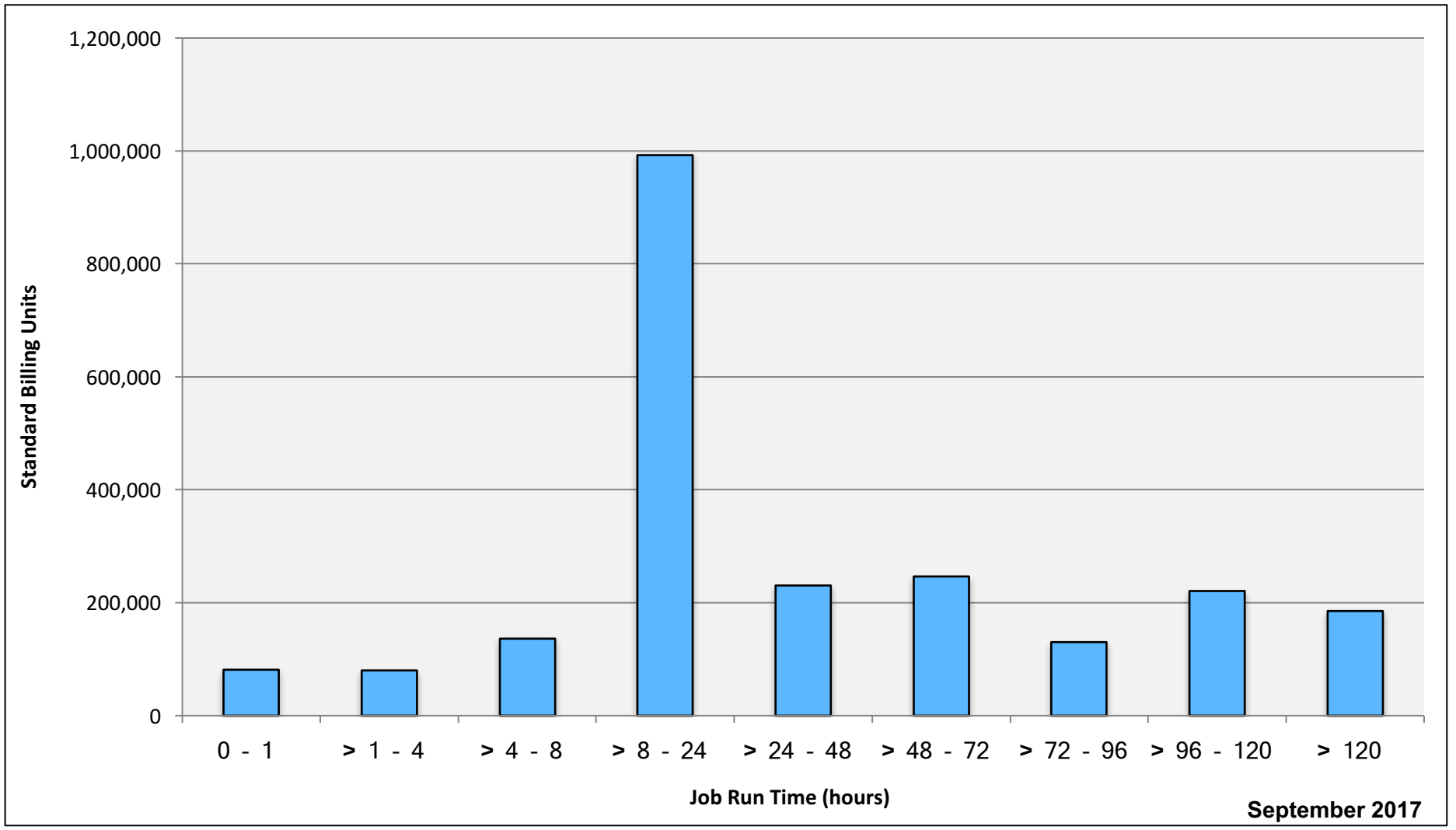
Electra:
SBUs Reported, Normalized to 30-Day Month



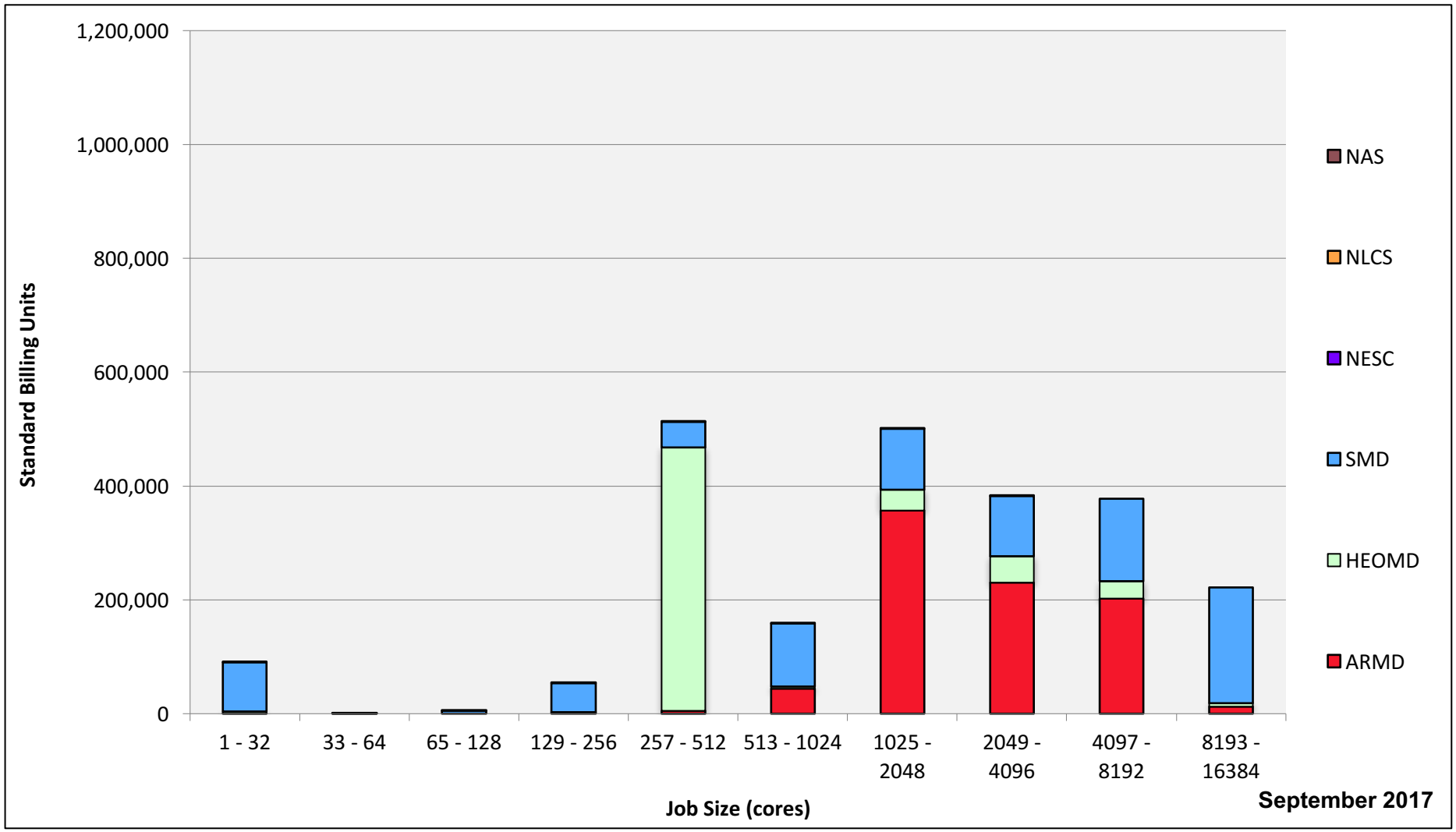
Electra:
Devel Queue Utilization



Electra:
Monthly Utilization by Job Length



Electra:
Monthly Utilization by Size and Mission



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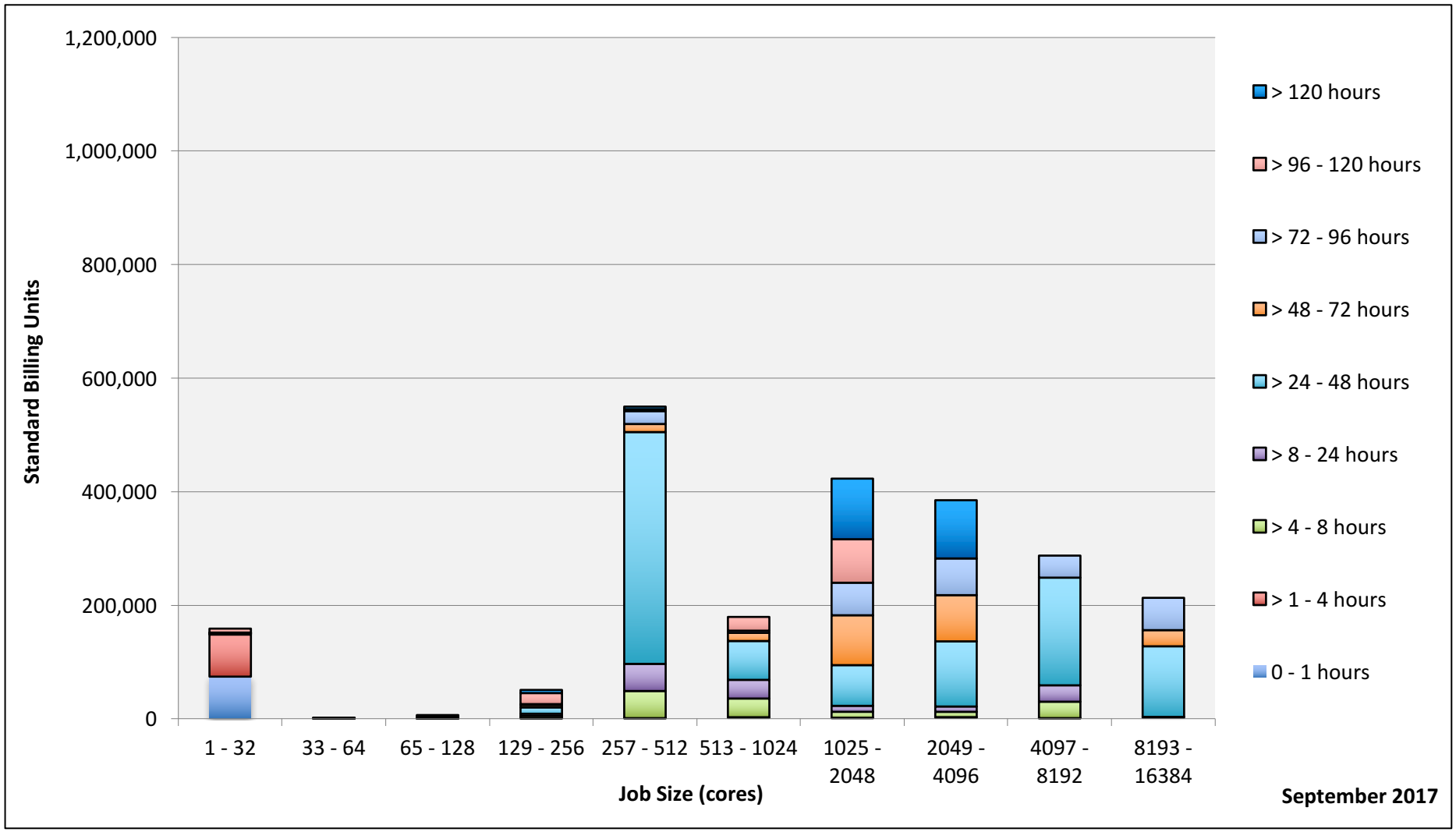
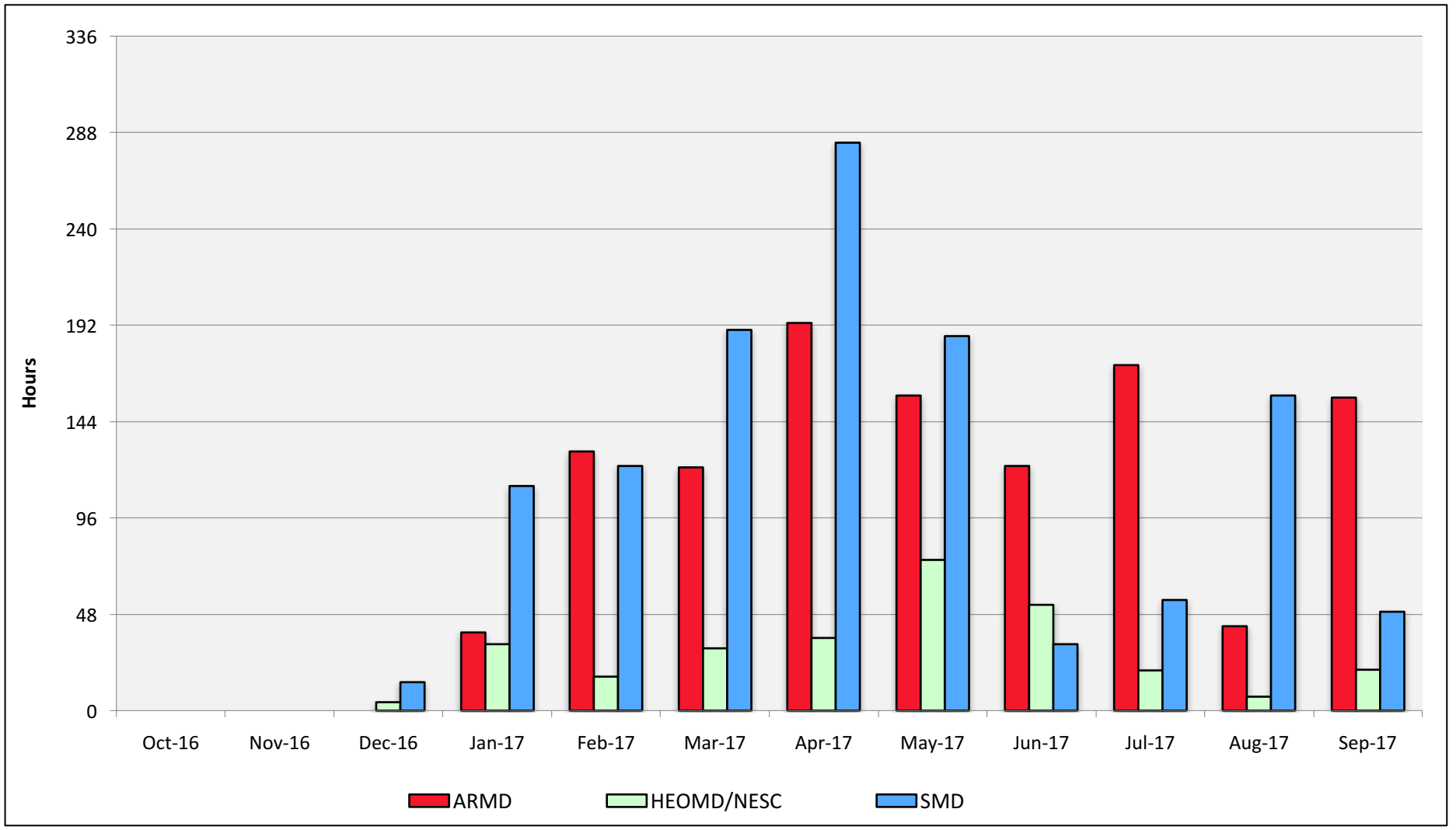
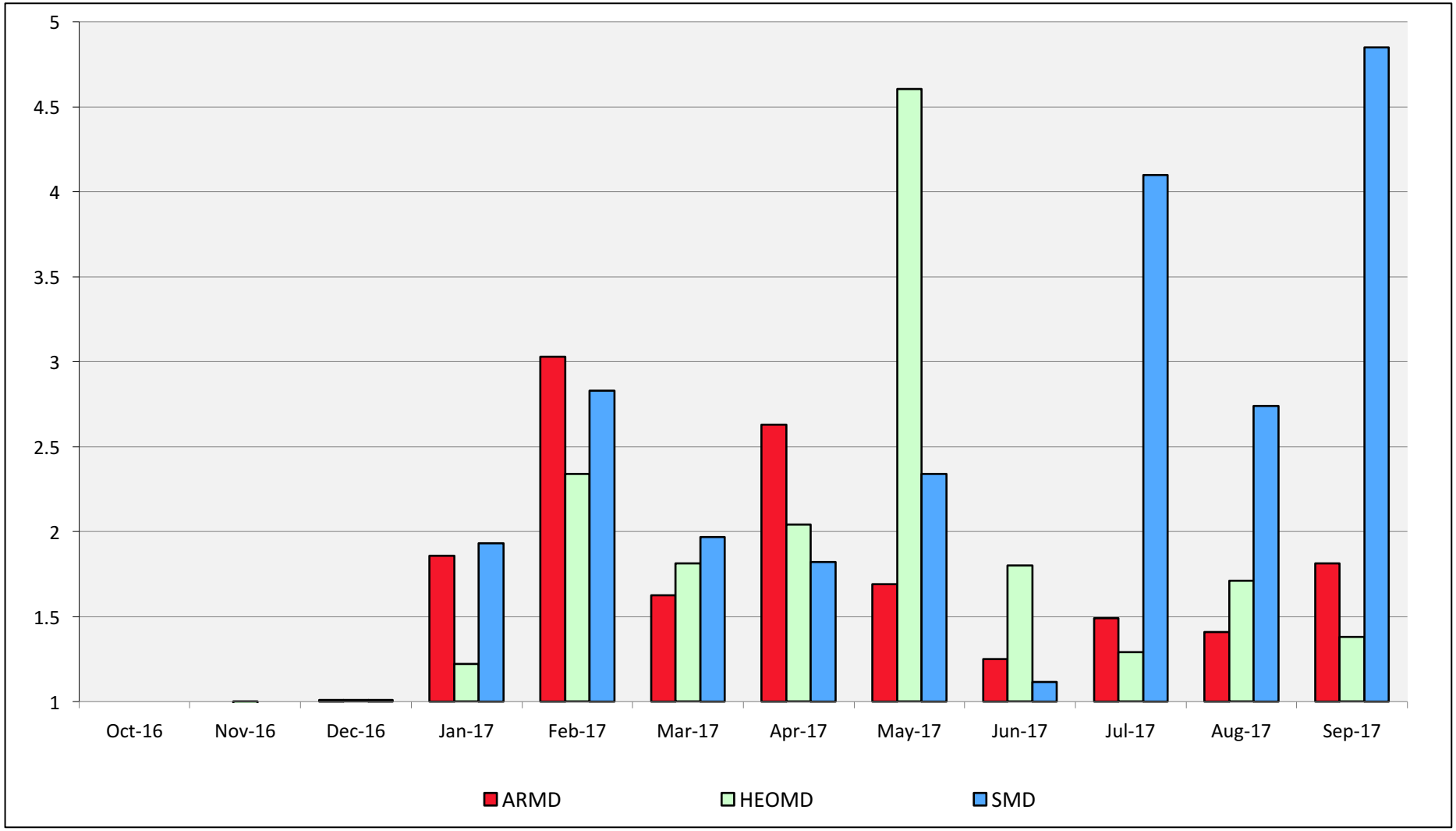


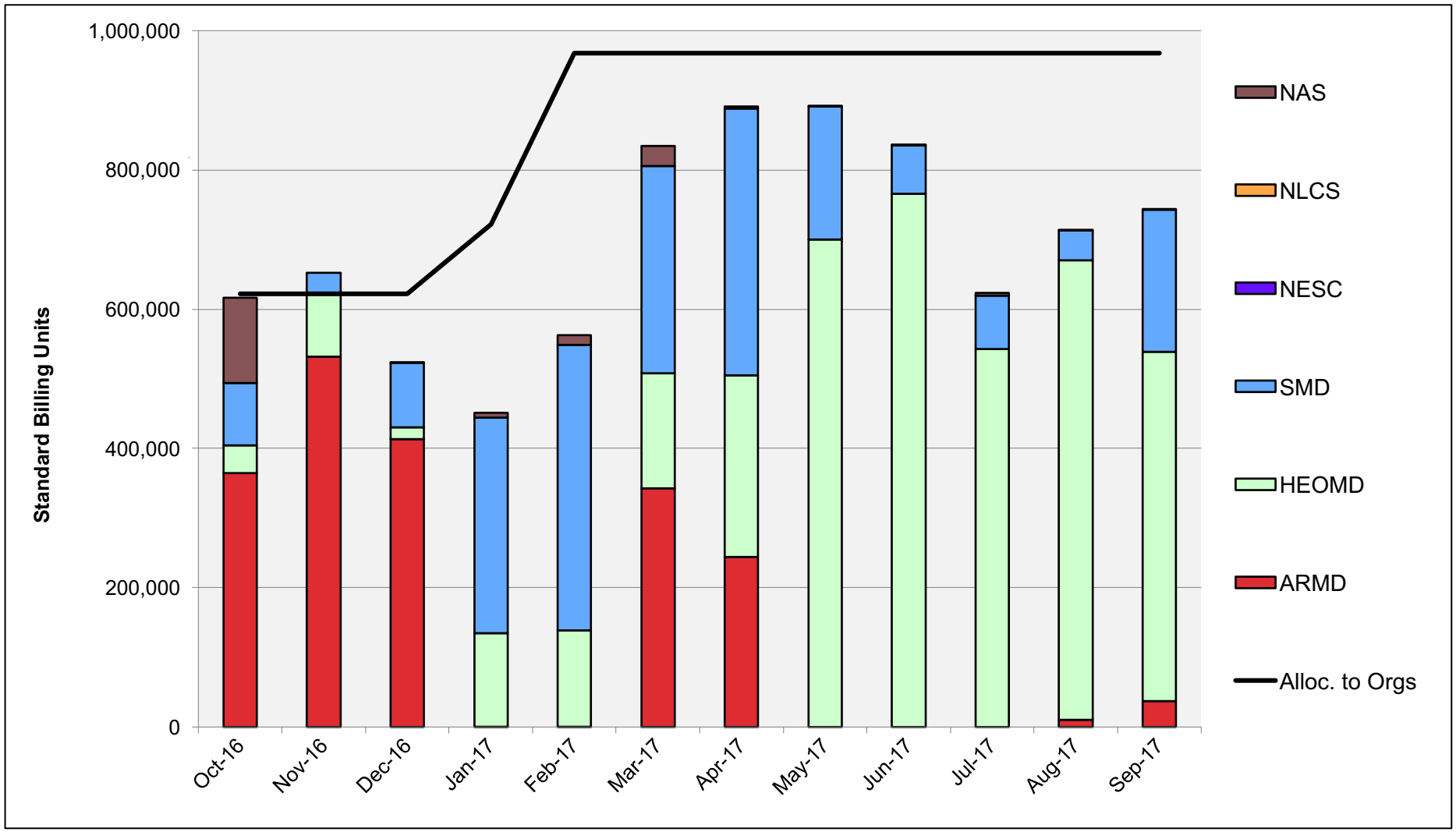
Electra:
Average Time to Clear All Jobs



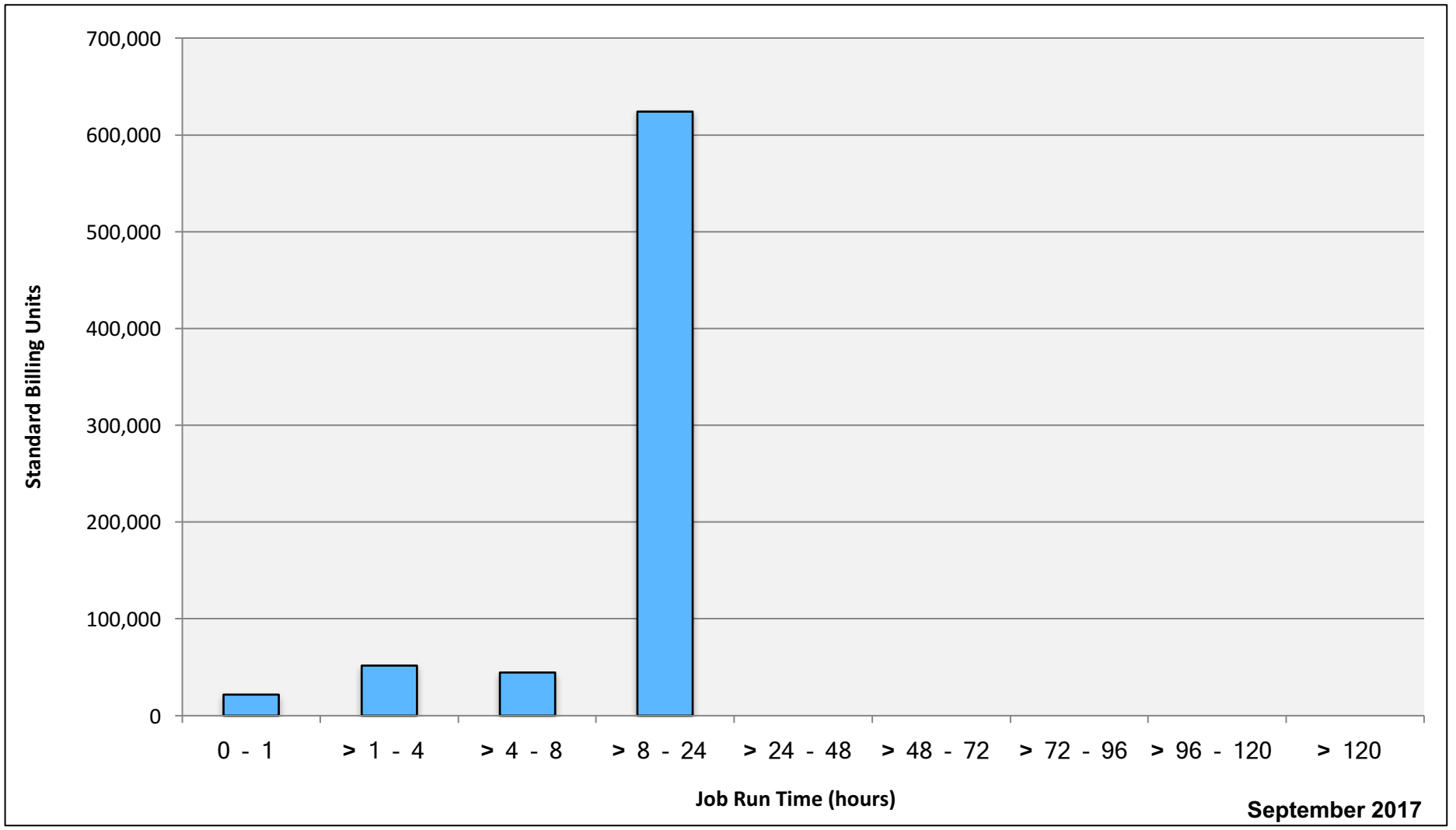
Electra:
Average Expansion Factor



Merope:
SBUs Reported, Normalized to 30-Day Month



Merope:
Monthly Utilization by Job Length



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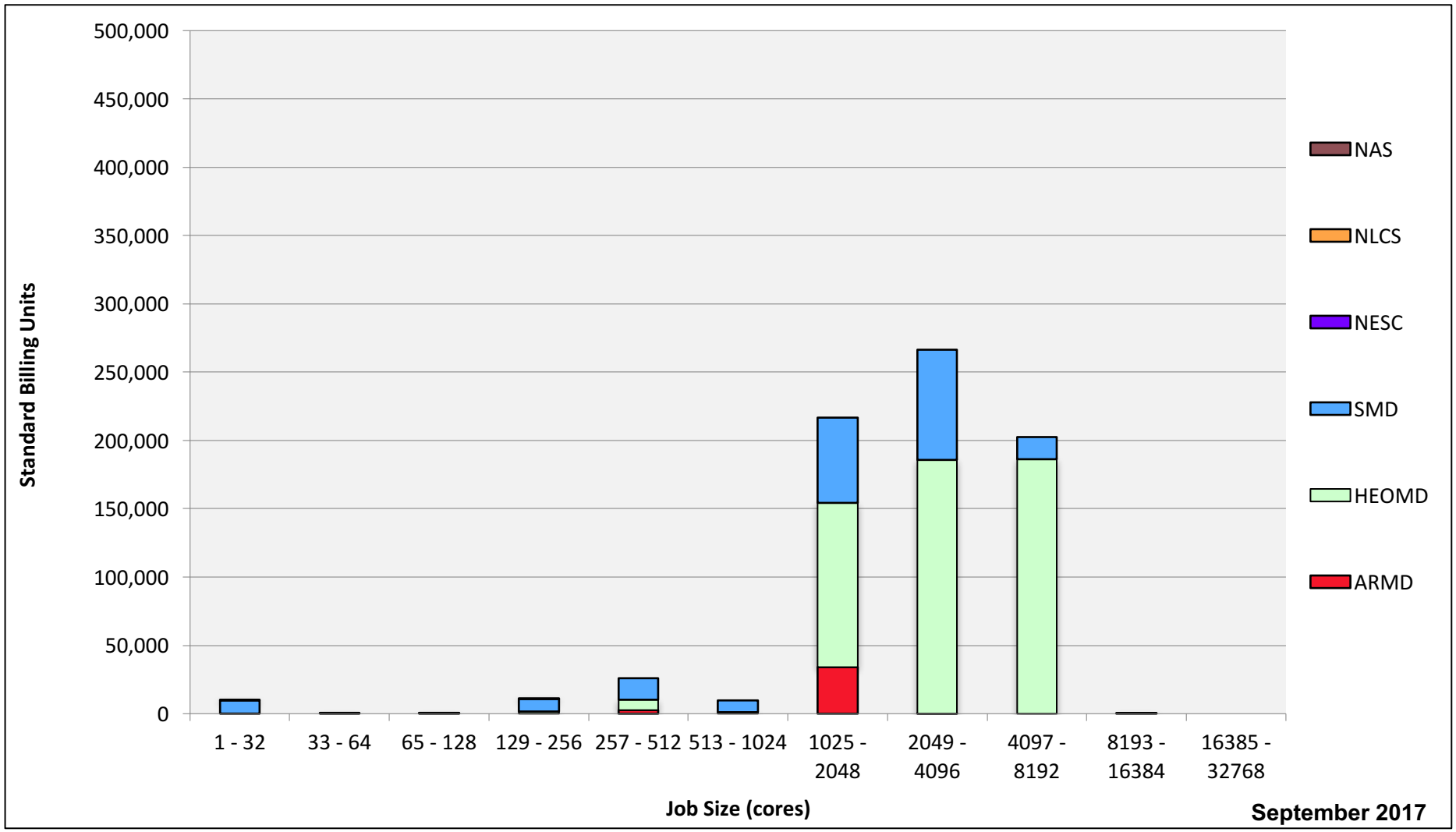
Monthly Utilization by Size and Mission



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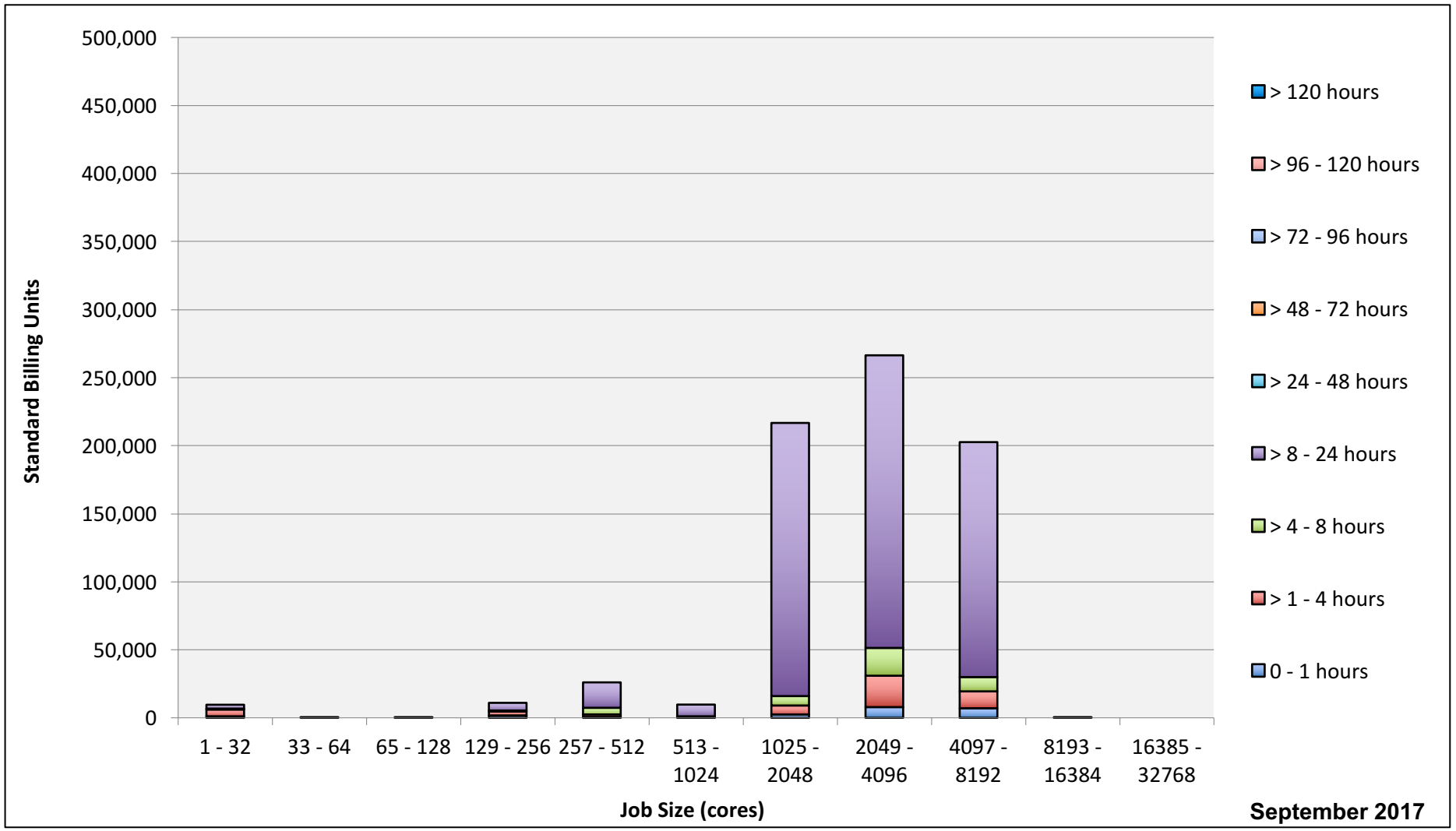

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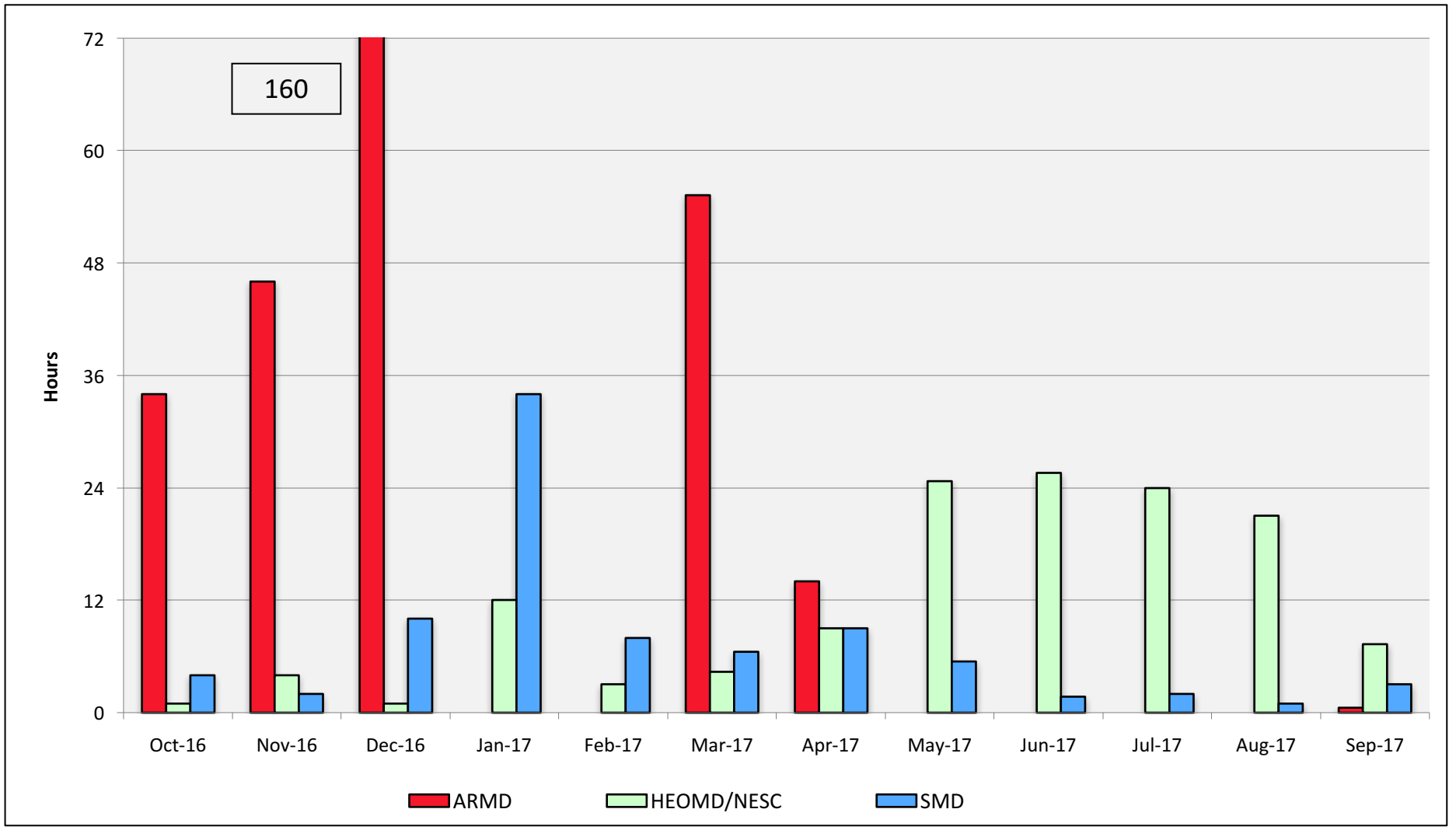

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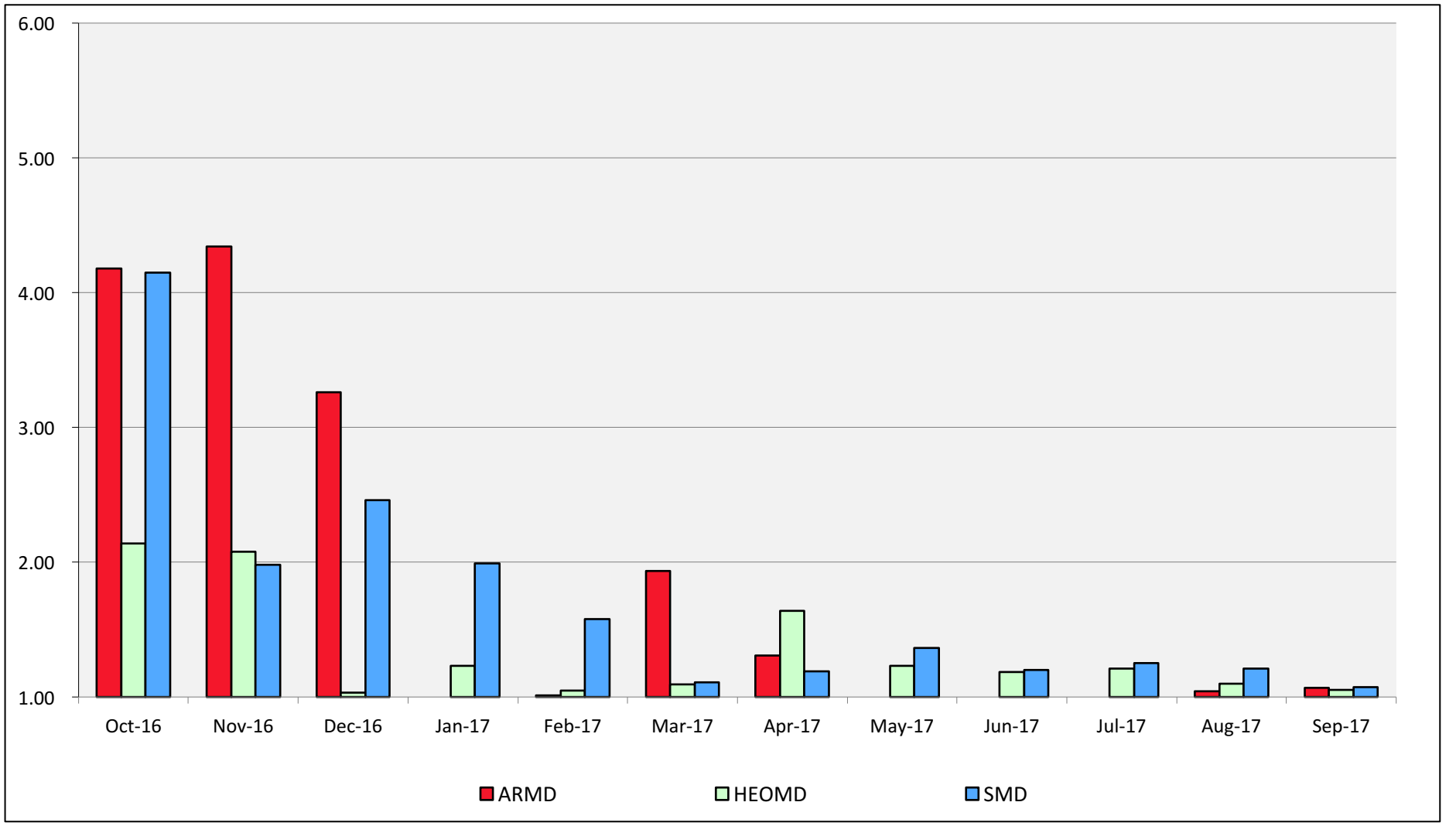
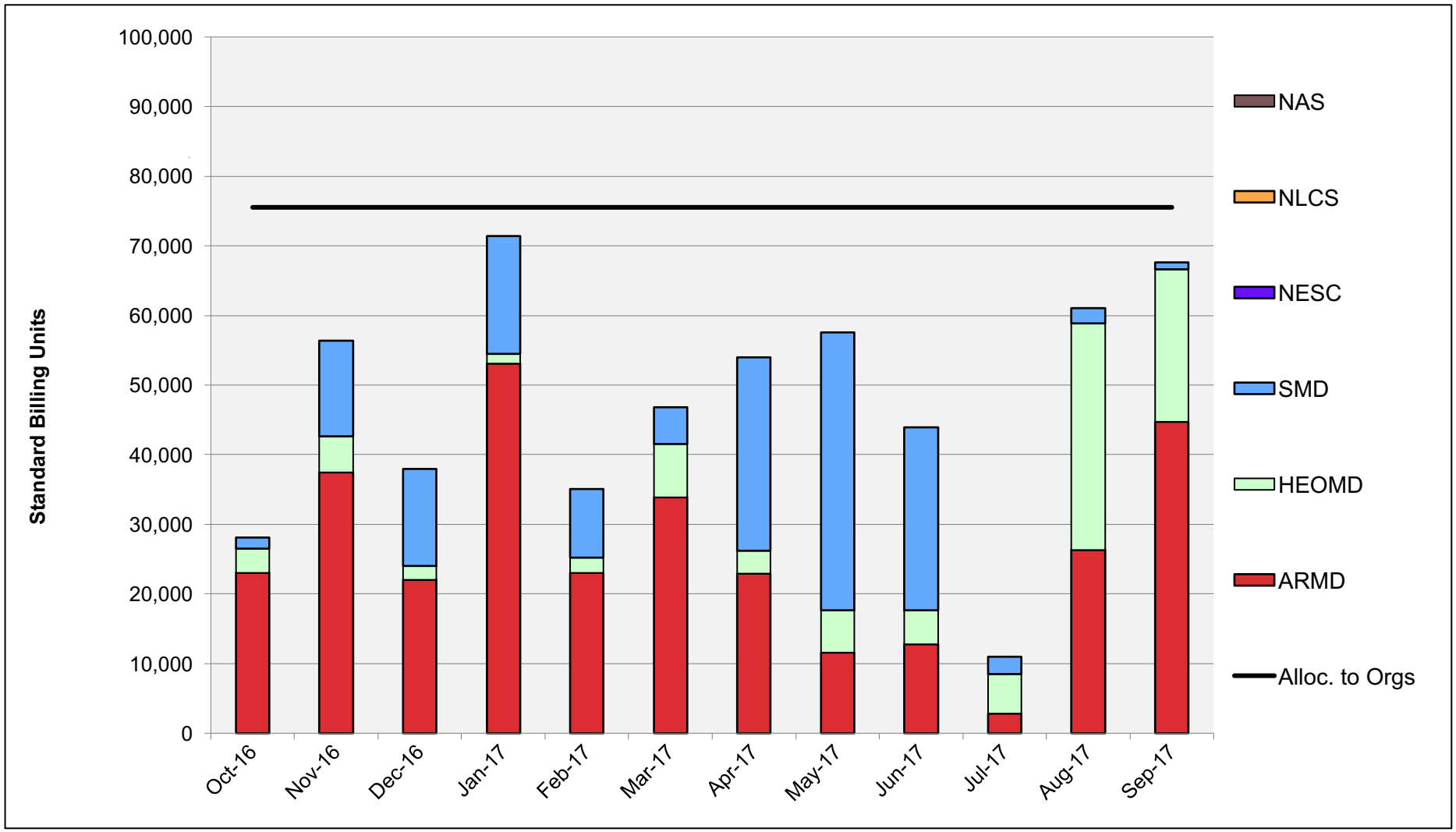


Endeavour:
SBUs Reported, Normalized to 30-Day Month



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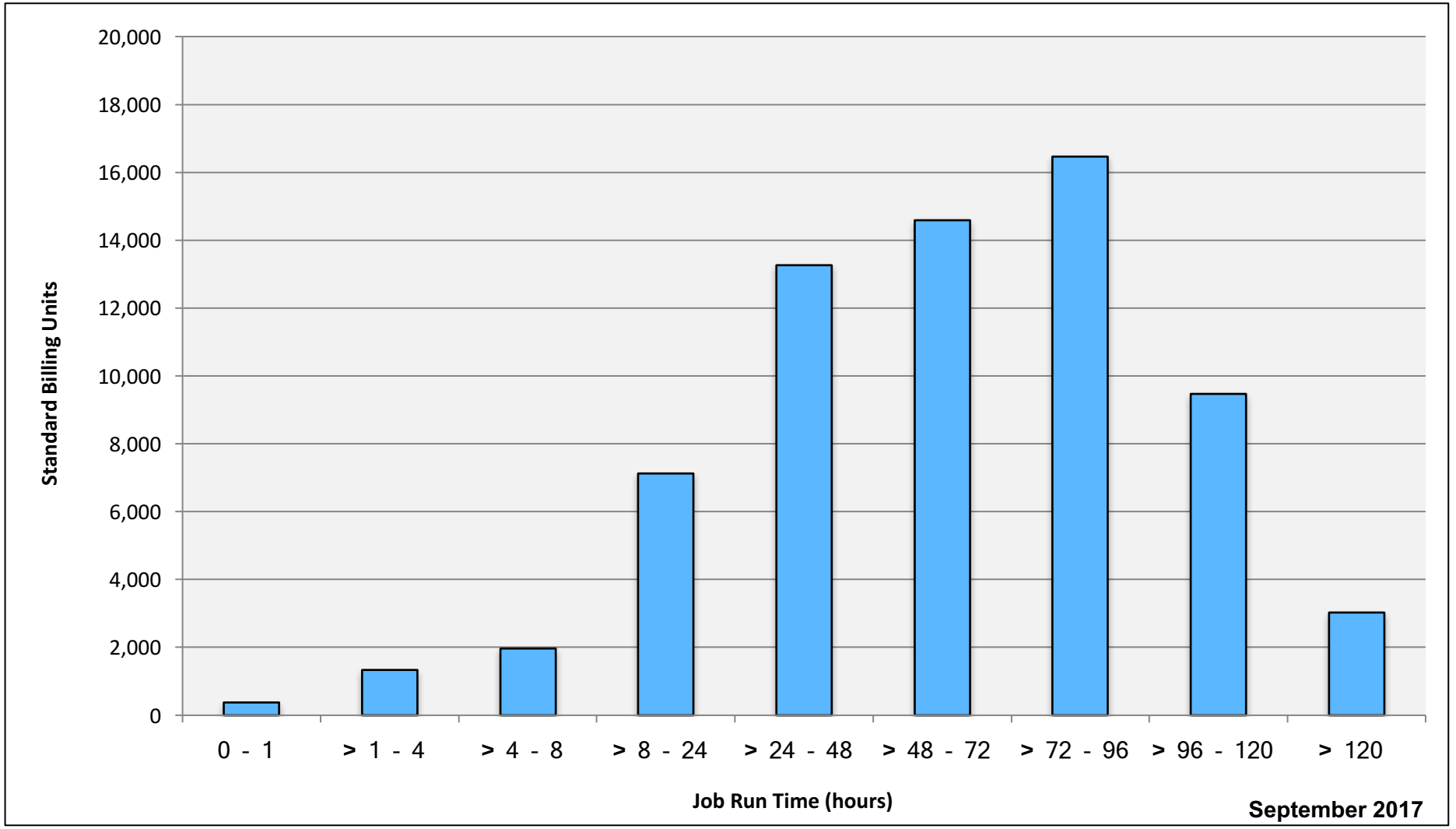
Monthly Utilization by Job Length



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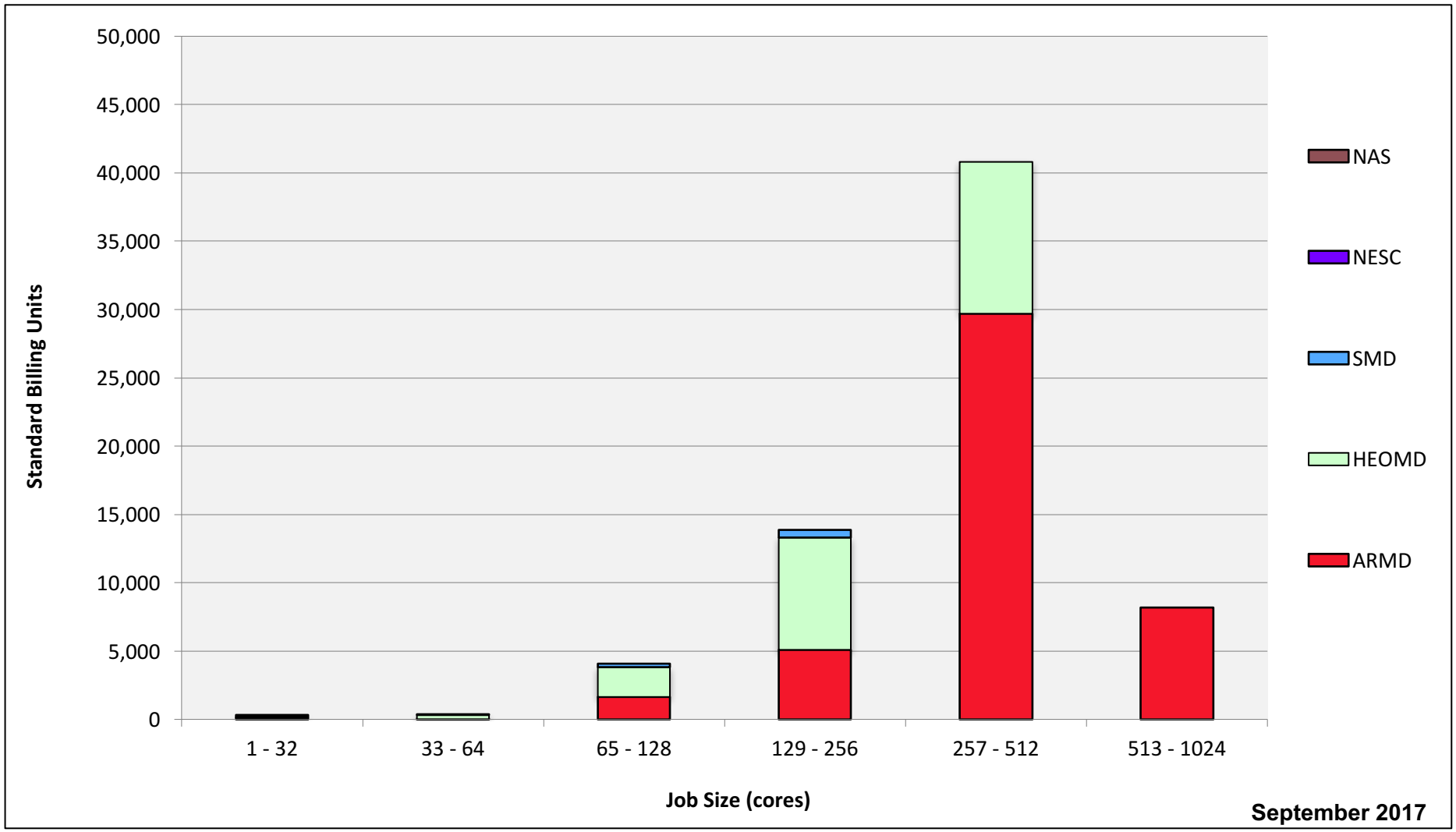

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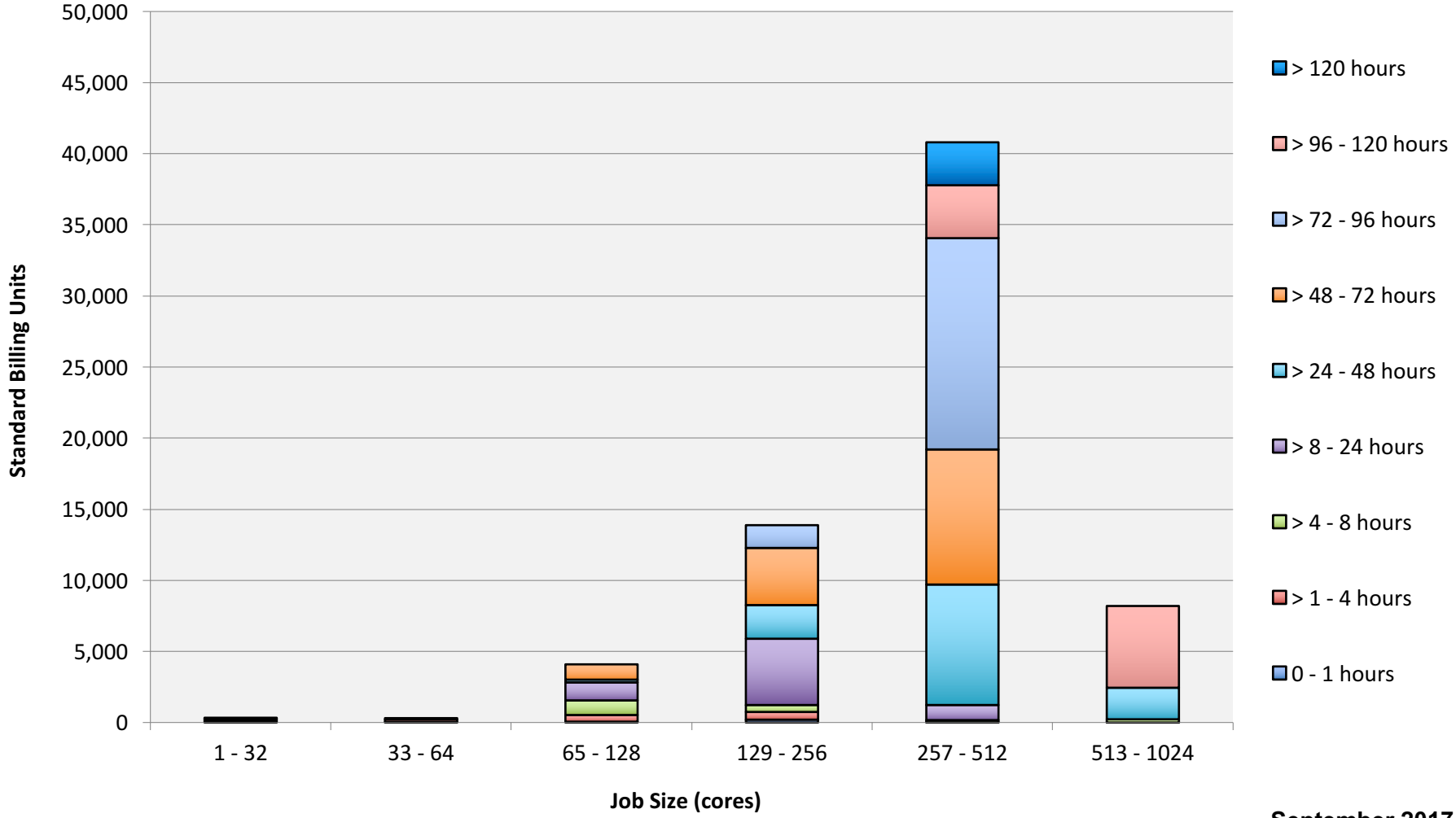

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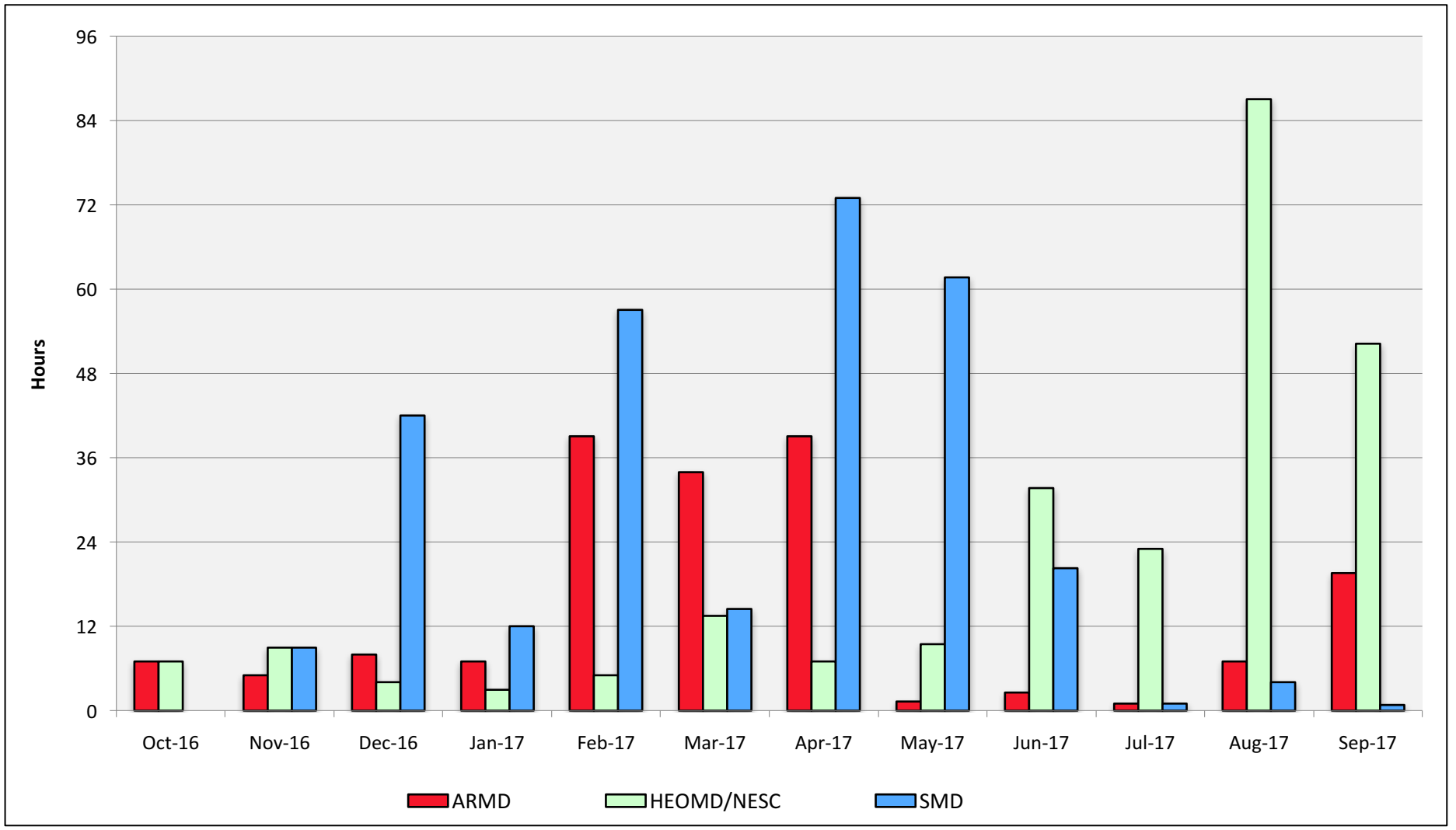

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